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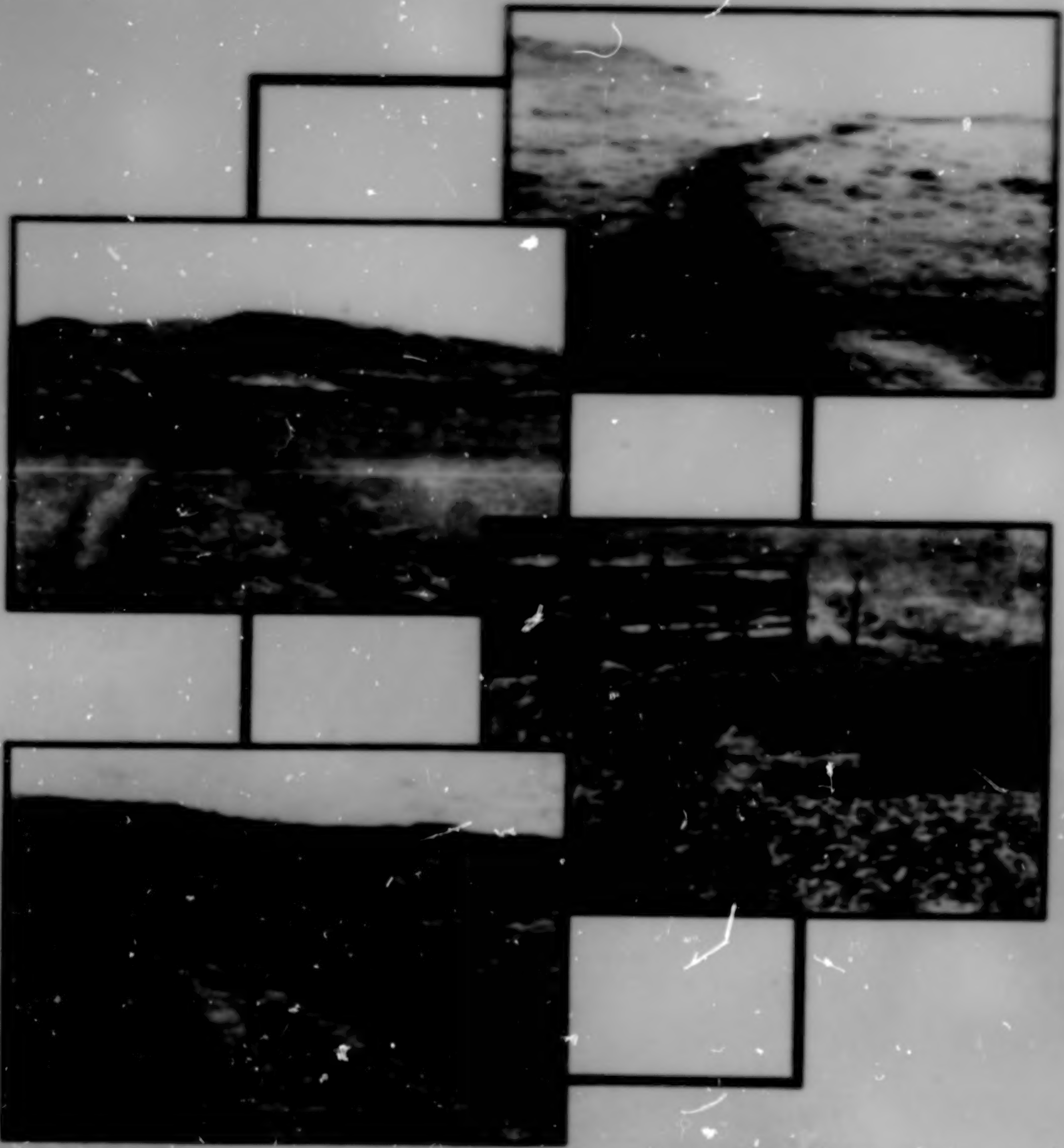
U.S. Department of the Interior
Bureau of Land Management
Wyoming State Office

Buffalo Field Office

December [illegible]

Wyodak Drainage Coal Bed Methane Environmental Assessment (WY-070-01-034)



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2003-015156/NF

MISSION STATEMENT

It is the mission of the Bureau of Land Management to sustain the health, diversity, and productivity of the public lands for the use and enjoyment of present and future generations.

BLM/WY/PL-[illegible]

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United States Department of the Interior

BUREAU OF LAND MANAGEMENT
Buffalo Field Office
1425 Fort Street
Buffalo, Wyoming 82834-2436

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Dear Reader:

Enclosed is a copy of the Wyodak Drainage Environmental Assessment (EA). The EA evaluates one action alternative. Several other alternatives were considered but eliminated from further detailed analysis. The No Action Alternative was not considered in detail because the Bureau of Land Management does not have a discretionary decision to make regarding whether federal protective wells would be allowed. An operator's drilling and producing obligations to the BLM on federal leases are described at 43 CFR 3162.2. Operators must drill diligently and produce continuously to protect the federal government from royalty loss resulting from drainage. Under these regulations, a No Action Alternative would not be in compliance with 43 CFR 3162.2.

Comments will be accepted until February 7, 2001. All substantive comments received will be taken into consideration before making a decision regarding the proposed action.

Preliminary Findings of No Significant Impact (FONSI)

Based on the analysis of potential environmental impacts, I have determined that the Proposed Action is not a major Federal action significantly affecting the human environment. Therefore, preparation of an Environmental Impact Statement is not required.

Rationale for the Findings

The impact analysis in this EA identifies the effects of additional drilling of up to 2,500 wells in the next fifteen months to prevent drainage within the Wyodak CBM project area. This EA is tiered to the 1999 Wyodak EIS. The alternative that was decided upon in the Wyodak EIS was alternative 1 (drilling of 5,000 new CBM wells). Cumulative effects were analyzed in the EIS. The cumulative effect levels of impact from the Wyodak EIS for the approved alternative, are being used as a threshold level for this EA in order to judge significance of impact.

An analysis of impacts from overall continued CBM development within the Powder River Basin of Wyoming was initiated in May, 2000 with the scoping of issues for the Powder River Basin Oil and Gas EIS. A decision for this new EIS is anticipated in about 15 months. The analysis in the EIS will include the completion of air quality, groundwater and surface water computer models to analyze impacts. The results of the analyses for this EA will be included in the PRBO&G EIS analysis.

Surface Disturbance

The Wyodak EIS' analysis determined the alternative selected in the ROD would disturb a total of 26,551 acres. Of this total, 103 acres were associated with compressor stations. Thus, 26,448 acres were expected to be disturbed for pads, roads, pipelines, and Pod facilities.

Since the Wyodak EIS ROD was published, the BLM has monitored disturbance associated with the new wells and ancillary facilities. Results of this monitoring suggest the actual areal extent of the 1,063 federal wells and associated facilities is 1,470 acres. This disturbance equates to an actual rate of about 1.38 acres of disturbance per well.

Assuming this actual rate of disturbance remains constant through implementation of the PA, the cumulative drilling of 12,501 wells (includes Wyodak EIS wells, the PA's 2,500 wells, and projected state and fee wells) would affect 17,251 acres. This figure is well below the total areal extent of disturbance projected in the Wyodak EIS (26,440 acres) for these facilities. Thus, disturbance associated with the PA in addition to those associated with the 1999 Wyodak project do not exceed the level of effect disclosed in the Wyodak EIS and ROD.

Air Quality

No additional compression facilities are anticipated for the proposed action therefore, no additional impacts beyond that analyzed in the Wyodak EIS are anticipated.

Water

Based on the BLM's and WOGCC's current projection for increased numbers of wells and their compilation of water production data for existing wells, total water production for 1,425 new producing protective federal wells would be approximately 98,172 acre feet over the 15-month period or about 82,000 acre feet for the 12-month period ending February 28, 2002. This estimate is based on the WOGCC's recent compilation of federal and state water production data for existing CBM wells (WOGCC 2000a). For the 6-month period of January 2000 through June 2000, the discharge rate from producing wells averaged 11.1 gallons per minute (gpm). Applying this same production rate of 11.1 gpm per well over the same 15-month period to 4,093 existing producing wells (as of November 30, 2000), to a projected 1,611 new state and fee producing wells, and to the proposed production from the 1,425 federal protective wells, water production would total approximately 127,497 acre feet (as of February 28, 2002) or about 107,060 acre-feet per year based on the previous 12 months of projected production.

The maximum rate of water production under the approved action for the Wyodak EIS was estimated to be 101.8 mgd or 114,030 acre-feet per year (Wyodak FEIS, p. 4-43). The comparison between the projected volumes of water to be produced daily and annually under the PA in combination with existing well water production and the volumes for the approved action in Wyodak EIS indicates CBM-generated flows for the PA would be less than those volumes estimated in the Wyodak EIS.

Comments can be submitted to Paul Beels at the [illegible] Buffalo Field Office, 1425 Fort St., Buffalo, Wyoming 82834, email: buffalo_wymail@blm.gov. For more information call Paul Beels or Richard Zander at 307/684-1100.

Sincerely,

Dennis R. Stenger
Field Manager

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CHAPTER 1
PURPOSE AND NEED FOR ACTION

INTRODUCTION

Over the last few years the production of coal bed methane (CBM) in Wyoming's eastern Powder River Basin (PRB) has dramatically increased. Since the early 1990s the U.S. Bureau of Land Management (BLM) has completed numerous Environmental Assessments (EAs) and two Environmental Impact Statements (EISs) analyzing CBM projects. The last of these was the Wyodak CBM Project EIS (Wyodak EIS), which was completed in November 1999. The Wyodak EIS project area contains 7,600 square miles of mixed federal, state, and private lands. Only 9.3 percent of the surface is federally owned, and 54 percent of the oil and gas is federally owned. The ownership pattern of the both surface and mineral estates consists of intermingled federal, private, and state parcels (Maps 1-1, 1-2, 1-3, and 1-4) (USDI BLM 1999a and 1999b).

Rapid development of private (fee) and state wells occurred during 1998-1999 while a moratorium on new federal wells was in place during the preparation of the Wyodak EIS. BLM staff has identified numerous situations where the pressure in underground coal seams, reservoirs for CBM, has dropped to a level at which methane gas will begin to desorb from the coal. A loss of methane would then occur if the desorbed gas is free to move out of the reservoir.

CBM wells drilled on state and fee leases adjacent to undeveloped federal CBM leases may result in a decrease in hydrostatic pressure on federal leases. When hydrostatic pressure is reduced sufficiently, methane on the federal leases will begin to desorb, and may be drained by adjacent wells on state and fee leases. This is not only a loss of federal mineral royalties but also leaves unrecoverable methane gas. In order to efficiently and economically recover the CBM resources, federal wells must be drilled and produced to prevent the loss of the CBM resource and royalties. Extensive drilling of scattered fee and state wells among the intermingled federal mineral estate during the preparation of the Wyodak EIS dramatically increased the extent and magnitude of federal potential drainage situations (PDS) within a very short period of time.

LOCATION OF THE PROPOSED ACTION

The proposed CBM drainage project would be located in eastern PRB including portions of Campbell, Converse, Johnson, and Sheridan counties (Map 1-1). The wells would be located within a project boundary extending from approximately 15 miles north of Gillette, Wyoming to 24 miles south of Wright, Wyoming. Wells would be located on lands adjacent to the coal mines along the eastern project boundary, and would extend to a western boundary located about 18 to 36 miles to the west. For reference, this roughly rectangular area has been named the Wyodak project area. The Wyodak project area includes portions of the Thunder Basin National Grassland (TBNG), managed by the U.S. Forest Service (FS). Drilling activity has been proposed on FS-administered federal lands.

RELATIONSHIP TO THE WYODAK CBM PROJECT EIS

The Wyodak EIS, completed in November 1999, was designed to be a programmatic analysis of the environmental effects expected to occur as a result of CBM activities in the eastern PRB (Map 1-1). During CBM activities, the environment can be expected to be affected on several levels or scales. This type of analysis presents an overview of the environmental effects of CBM development.

The Wyodak EIS analyzed a reasonably foreseeable CBM scenario for the eastern PRB when the analysis began in April 1998. A much higher level of CBM activity has occurred. This Wyodak CBM Drainage Environmental Assessment (Drainage EA) considers federal PDS, which is an extension of the existing analysis contained in the Wyodak EIS. Therefore, the Drainage EA is tiered to the Wyodak EIS. When the anticipated impacts from CBM development differ significantly from the cumulative impacts analyzed in the Wyodak EIS, another development stage (a regional programmatic EIS for as yet unspecified development levels) will be analyzed. This Drainage EA also updates the NEPA compliance for the BLM's Buffalo Resource Management Plan (RMP).

The approved project for the Wyodak EIS consisted of 5,000 new productive CBM wells. About half of these were expected to be federal wells and the rest were expected to be fee and state wells. The total number of productive wells analyzed in the Wyodak EIS has been reached. No new federal CBM wells, including those needed to resolve federal drainage issues, can be approved until an environmental analysis is completed. The federal protective wells considered in this EA will be situated within the Wyodak EIS project area.

Drilling CBM protective wells on lands where mineral rights are owned and controlled by the federal government must be conducted under an approved application for permit to drill (APD) issued by the BLM. In considering whether to approve APDs, the BLM must consider possible project-specific and cumulative environmental impacts to ensure compliance with NEPA. This EA has been prepared to meet that requirement. An additional analysis, which will look at the site-specific impacts of the drilling location and its relationship to the range of impacts documented in this analysis, will be completed in response to the filing of an APD and prior to approval by the BLM.

Subsequent, site-specific environmental analysis will be tiered to the programmatic Wyodak EIS and this EA, and used to support Application for Permit to Drill/Plan of Development (APD/POD) level decisions relating to a specific CBM protective well or group of CBM protective wells. Detailed natural resource data on wildlife and fisheries populations and habitats in a specific area, and other site-specific information on natural resources, environmental quality, and land uses will be analyzed to supplement the analyses contained in the Wyodak EIS and this EA.

The BLM's authority and decisions related to CBM development in the eastern PRB are limited to the agency's stewardship, resource conservation, and surface protection responsibilities for federal lands and minerals. As conservator of the federal surface and mineral estate, the BLM has responsibility for ensuring that the federal mineral resource is conserved (not wasted) and is developed in a safe and environmentally-sound manner. However, the BLM does not authorize or control any of the following:

- CBM development involving only fee or state-owned lands and minerals;
- The appropriation (withdrawal) or subsequent beneficial use of groundwater;
- Water quality;
- Discharge permits for CBM produced water;
- Injection of CBM produced water;
- With the exception of BLM-administered surface ownership, surface water diversions, stream channel modifications, construction of new reservoirs, reservoir supply, or dam modifications to existing reservoirs; or
- Air quality permitting for stationary or mobile sources of air pollution and regional haze.

Regulatory areas where the BLM has shared responsibilities with other federal or state agencies include the following:

- Oil and gas drilling and associated federal-lease development activities;
- Oil and gas well spacing;
- Activities that would impact waters of the U.S.;
- Special status species of plants or animals; and
- Cultural, historical, or paleontological resources.

When actual locations and operational requirements for gas compression facilities supporting CBM development are determined, permit applications would be submitted to the Air Quality Division (AQD) of the Wyoming Department of Environmental Quality (WDEQ). At that time, additional site-specific air quality analyses, such as a Best Available Control Technology (BACT) analysis or Prevention of Significant Deterioration (PSD) increment analysis, may be performed. The analysis contained in this EA is not intended as an air quality regulatory determination. PSD increments are used here only to evaluate air quality impacts.

RELATIONSHIP TO THE ONGOING POWDER RIVER BASIN PROJECT EIS

This EA analyzes the impacts from the drilling, completion, and production of federal protective CBM and associated produced water over a time period of approximately 15 months. An analysis of impacts from overall continued CBM development within the Powder River Basin of Wyoming, as projected by the CBM industry, has been initiated with the scoping of issues for the Powder River Basin Oil and Gas EIS. A decision at the end of this new EIS process is anticipated in about 15 months. The results of the analyses for this EA will be included in the EIS analysis.

PURPOSE AND NEED

The purpose of, and need for, continuing CBM production is to allow BLM to authorize drainage wells to eliminate the ongoing loss of royalties and to help meet the energy needs of the nation. Continuing CBM development of federal protective wells would enhance recovery of methane from the Wyodak EIS project area and would limit the loss of royalties to the U.S. and the State of Wyoming.

Drainage is an economic issue. The federal government and the State of Wyoming are losing royalties on methane drained from the federal mineral estate by producing fee and state wells situated adjacent to federal mineral estate lands. BLM staff projected that for an estimated 2,500 protective wells, the monetary value of royalty lost over two years would be $26 million if the protective wells were not drilled and produced in a timely manner.

CBM protective wells must be drilled on federal mineral estate lands, in accordance with the BLM's responsibilities under 43 CFR 3162.2, to prevent additional drainage of federal CBM. The BLM proposes to require the development of federal CBM in PDS by increasing the total number of federal wells and ancillary facilities where economically feasible, and where the direct and indirect impacts of federal protective wells do not differ significantly from the impacts disclosed in the Wyodak EIS.

Federal drainage protective wells are necessary to prevent the loss of the methane gas resource and loss of royalties owed to the federal government, and to protect correlative rights of lessees. These wells cannot be approved until an environmental analysis that complies with NEPA is completed. The limited number of wells analyzed in this EA will not resolve all federal drainage issues. This analysis documents the cumulative impacts of federal protective wells that potentially could be approved, through an APD/POD level analysis and decision, and drilled while a new EIS is being prepared. The cumulative impacts of reasonably foreseeable CBM and conventional oil and gas development within the Wyoming portion of the PRB are being analyzed in the Powder River Basin Oil and Gas EIS. The analysis in the new EIS will include the completion of air quality and groundwater impact analyses based on computer models. Both the Drainage EA and the new regional EIS will also update the NEPA compliance for the BLM's Buffalo and Platte River RMPs.

The purpose of the Proposed Action is to analyze the impact of additional development of federal CBM properties that were not analyzed in the Wyodak EIS. This development would occur where a PDS exists within the Wyodak project area. As of November 30, 2000, an estimated 4,093 producing CBM wells were in place within the Wyodak project area.

An operator's drilling and producing obligations are described at 43 CFR 3162.2. Drainage of federal methane is addressed in accordance with the BLM's Instruction Memorandum No. 99-051, which describes the agency's responsibilities in identifying and evaluating federal PDS through non-NEPA administrative and technical reviews. The operator must drill diligently and produce continuously to protect the lessor (federal government) from loss of royalty by reason of drainage. Protective wells must be drilled within a reasonable time period where the BLM determines that drainage may exist, unless another option such as payment of compensatory royalty is applied.

Consistency with Land Use and Resource Management Plans and Other Oil and Gas and Coal Decisions

The BLM's principal authority for managing the public lands is the Federal Land Policy and Management Act of 1976 (FLPMA, PL 94-579, 43 USC 1701-1782 [Supp. 1977]). Under this Act, the BLM is responsible for managing the public lands:

- Under the principals of multiple use and sustained yield;
- In a manner that recognizes the Nation's need for domestic sources of minerals, food, timber, and fiber from the public lands;
- In accordance with land use plans developed under the Act; and
- In a manner that protects the quality of scientific, scenic, historical, ecological, environmental, air and atmospheric, water resource, and archaeological values.

BLM's planning regulations, which are set forth in 43 CFR 1600, implement this direction.

In 1985, the BLM completed a land use plan (i.e., the Buffalo Resource Management Plan (RMP) for the Buffalo Field Office administrative area (BFOA). The Buffalo RMP provides the direction for implementing the requirements of the FLPMA on the BLM-administered public lands and federal mineral estate in the BFOA.

The 1985 Buffalo RMP was revisited and evaluated, including public participation, from 1992 through 1997. The evaluation resulted in a determination that the RMP planning and management decisions were still valid. The management decision from the RMP for oil and gas states, "Continue to lease and allow development of federal oil and gas in the Buffalo Area". This decision applies to any type of oil and gas development and does not distinguish between conventional oil and gas and coal bed methane (CBM) leasing and development. Standard stipulations and mitigation guidelines for resource protection are incorporated from the RMP and attached to lease parcels prior to their advertisement and sale. The "Wyoming BLM Mitigation Guidelines for Surface Disturbing and Disruptive Activities" became part of the RMP through maintenance in 1990. These mitigation guidelines have been utilized as a tool during RMP EIS supplemental CBM impact analyses to: (1) develop a baseline for measuring and comparing impacts among the alternatives; (2) to identify other actions and alternatives that should be considered, and (3) help determine whether more stringent or less stringent mitigation measures should be considered. Standard lease stipulations and the Wyoming Mitigation Guidelines can be found in the Buffalo RMP.

Interest in CBM production development continued to expand through the 1990s. Environmental analyses were conducted and documented on a variety of CBM project proposals during that time. These include the Pistol Point, Marquiss, Lighthouse, Gillette North, Gillette South, and Wyodak CBM project proposals.

Each of these environmental analyses covered the effects of the proposed actions and alternatives, including the cumulative effects of the projects combined with other development and actions within the area.

Based on the evaluation of these project proposals in regard to the scope and meaning of the Buffalo RMP decisions, it was determined that amendments to the RMP (i.e., changing, adding or deleting RMP decisions) were not necessary. Although specific amendments to the RMP "decisions" were not needed, each of the analyses for these project proposals served to supplement and update the analysis in the EIS for the Buffalo RMP. The EIS for the Wyodak Coal Bed Methane Project, which is the most current of the aforementioned analyses, was completed in November 1999 and updated the analysis in the EIS for the Buffalo RMP to that point in time.

The impact analysis in this EA identifies the effects of drilling additional wells to prevent drainage within the Wyodak CBM project area. This EA is tiered to the 1999 Wyodak EIS. The alternative that was decided upon in the Wyodak EIS was Alternative 1 (drilling of 5,000 new CBM wells). The cumulative effects levels of impact from the Wyodak EIS for that alternative are being used as a threshold level for this EA in order to judge significance of impact.

Based on the above information, the preliminary review of the impacts of this proposed action against the management decisions in the Buffalo RMP indicate that the action is in conformance with the RMP. The decision record for this EA will disclose whether the new information and circumstances related to this proposed action warrant an amendment (change in management decisions) to the Buffalo RMP.

AUTHORIZING ACTIONS

Federal Oil and Gas Leasing

The BLM's Buffalo Field Office (BFO) administers oil and gas leases for all federally-owned minerals within the Campbell, Johnson, and Sheridan county portion of the Wyodak project area. The BLM's Casper Field Office (CFO) administers oil and gas leases for all federally-owned minerals within the Converse County portion of the Wyodak project area. CBM development is regulated in accordance with lease terms and conditions, federal oil and gas regulations, and onshore oil and gas orders. An oil and gas lease grants the lessee the "right and privilege to drill for, mine, extract, remove and dispose of all oil and gas deposits" in the leased lands, subject to the terms and conditions incorporated in the federal lease. Because the Secretary of the Interior has the authority and responsibility to protect the environment within federal oil and gas leases, restrictions are imposed on the lease terms.

The FS's Douglas Ranger District of the Medicine Bow-Routt National Forest administers oil and gas leasing and development activities within the TBNG. Leasing and development activities on FS-administered federal lands are subject to the limitations imposed by the *Land and Resource Management Plan for the Medicine Bow National Forest and Thunder Basin National Grassland* (LRMP)(USDA FS 1985) and the EIS for *Oil and Gas Leasing on the TBNG* (USDA FS 1994).

In April of 1994, the FS completed a Final Environmental Impact Statement (FEIS) and issued a Record of Decision (ROD) for oil and gas leasing on the TBNG. The ROD made a decision about leasing (36 CFR 228) and provides surface use guidance for developing oil and gas resources on the Grassland. The ROD identifies that the National Forest System lands in Thunder Basin are administratively available for oil and gas leasing, as per 36 CFR 228.102(d). It documents the decision to authorize the BLM to lease the lands using standard lease terms, or standard lease terms supplemented with lease stipulations. As required by Title 36 Code of Federal Regulations Part 228.102 (e), when a parcel is proposed for leasing a review of any new information or changed circumstances will be conducted before consent to lease (concurrence), authorizing the BLM to offer the parcel for lease.

The decision made in the 1994 ROD applies to any type of oil and/or gas development. It does not distinguish between conventional oil and gas development or coal bed methane leasing. When analyzing proposals and making decisions related to applications for a permit to drill coal bed methane wells, the FS has tiered to Wyodak FEIS analysis and ROD. This EA provides information that will be used to guide site-specific environmental effects analysis and decisions at the time of development of existing oil and gas leases for coal bed methane. Site-specific environmental effects analysis (the NEPA process) must and will contain documentation as to whether or not development of the gas well(s) proposed is consistent with the 1994 Oil and Gas Leasing FEIS and ROD, and the Medicine Bow National Forest and 1985 TBNG Land and Resource Management Plan (Forest Plan) as amended.

The Wyodak project area contains three Forest Plan management area prescriptions. These three Forest Plan management prescriptions with their goals and objectives are applicable to, and serve to direct the USDA Forest Service management, in the Drainage Environmental Analysis area. They are:

- 4B Management Prescription: Management emphasis is on the habitat needs of one or more management indicator (MIS) wildlife species identified for the area. The management goal is to provide effective and suitable habitat, and to maintain or increase the numbers of these species. Less than three percent of the National Forest System lands in the Drainage Environmental Analysis area is 4B management prescription.

- 6B Management Prescription: Management emphasis is on domestic livestock grazing. The management goal is to maintain range condition at, or above, satisfactory level. More than 97 percent of the National Forest System lands in the Drainage Environmental Analysis area is 6B management prescription.

- 9A Management Prescription: Management emphasis is on management of all the components ecosystems of riparian areas. This management area is located along streams, wetlands and other riparian areas within 4B and 6B management areas. The management goals include providing healthy, self-perpetuating plant communities, meeting water quality standards, providing habitats for wildlife and fish, and providing stable stream channels. Less than one percent of the National Forest System lands in the Drainage Environmental Analysis area is 9A management prescription.

The 1994 USDA Forest Service Final Environmental Impact Statement (FEIS) and Record of Decision (ROD) for oil and gas leasing on the Thunder Basin National Grassland (TBNG) found that development of the oil and gas resources is consistent with the 1985 Forest Plan. It found development of the oil and gas resources is consistent and compatible with the Forest Plan management prescriptions, goals, and objectives for the desired conditions of the land.

Based on the scope of environmental impacts associated potentially with coal bed methane and conventional oil and/or gas development, it has been determined that amendments to the 1994 Oil and Gas Leasing on the TBNG Record of Decision, and thus also the Forest Plan for the Medicine Bow National Forest and TBNG are warranted. The Forest Plan is currently being revised and updated. Decisions about any future leasing of coal bed methane resources are deferred until after completion of the Powder River Basin Oil and Gas EIS, FS concurrence, and the signing of the BLM ROD.

State of Wyoming

The Wyoming Office of State Lands and Investments is responsible for easements and temporary uses of state lands that are required for off-lease activities.

The Wyoming Oil and Gas Conservation Commission (WOGCC) regulates drilling and well spacing, and requires an approved APD for all oil and gas wells drilled in the state, including federal wells. Securing necessary legal access to and/or across any state- or privately-owned lands is part of the APD approval process. The WOGCC also regulates reserve pits and water encountered (surface flows) or produced during drilling operations.

Under current State of Wyoming laws, CBM operators are allowed to produce water with a CBM-use, Wyoming State Engineer's Office (WSEO) permit and to discharge that water with an NPDES permit from Wyoming Department of Environmental Quality (WDEQ). Producers operating with these permits are within the requirements of state laws. All additional beneficial uses of water after CBM permitting must be permitted with WSEO.

The State of Wyoming considers water produced in conjunction with CBM development to be a beneficial use of groundwater and requires an approved permit from the WSEO prior to the drilling of a CBM well. This WSEO permit authorizes the appropriation of groundwater from subsurface aquifers and its subsequent beneficial use at specific locations. Surface water diversion, stream channel modification, reservoir supply, construction of new reservoirs, and/or dam modification on existing reservoirs also require permits from the WSEO. Engineering designs are required, as appropriate, as part of the approval process.

The Water Quality Division (WQD) of the WDEQ regulates increasing sedimentation, erosion, and other issues affecting the quality of water. WQD also is responsible for granting a National Pollution Discharge Elimination System (NPDES) permit for surface discharge of produced waters from CBM wells. The

WDEQ's NPDES permitting process, effluent limitations, and monitoring requirements for CBM produced water currently are being re-evaluated. Specific requirements for discharge of CBM produced waters are being evaluated by WQD on a case-by-case basis.

The WQD also issues NPDES permits for pipeline construction activities that disturb five or more acres or involve temporary discharge to "Waters of the State" during hydrostatic testing. Beginning no later than May 31, 2002, construction projects that clear one acre or more will be required to obtain stormwater permit coverage. Types of oil and gas activities that may be covered include well pad construction, road construction, pipeline installation, and any other activity that results in clearing, grubbing, or grading of the land surface.

The WQD also administers a voluntary State Wetland Bank where landowners can temporarily "bank" newly-created wetlands as a wetlands credit. The existence of a non-wetland use is recorded to facilitate reversal of the decision creating the banked wetlands (if desired, as long as the wetland credit was not used as mitigation for another wetland impact). Where the U.S. Army Corps of Engineers (COE) exerts federal jurisdiction over banked wetlands, the outcome of decisions involving these wetlands will be in accordance with the federal regulations administered by the COE.

Other Federal, State, and Local Government Authorizations

Federal

Federal agencies are directed to take action to minimize the destruction, loss, or degradation of wetlands, and to preserve and enhance the natural and beneficial value of wetlands by Executive Order (EO) 11990, May 24, 1977 (Protection of Wetlands). A BLM instructional memorandum summarizing the permitting procedures used to implement this federal policy for all Wyoming wetlands administered by the BLM is included in **Appendix A**.

As part of the APD approval process for oil and gas drilling on federal lands and/or federal minerals it administers, the BLM reviews the surface use and drilling plans submitted by a company. For CBM development, BLM is asking operators to submit a Project Plan of Development (POD), which includes a master drilling plan, a master surface use plan, and a water management plan that covers all wells.

After the BLM receives a Notice of Staking (NOS) or an APD/POD and before approval, an onsite inspection is made of the proposed drilling locations, access roads, water management, and all other potentially disturbed areas. BLM personnel, company representatives, and the surface owner(s) usually attend the inspection to determine site-specific conditions for approving the APD/POD. As part of the APD/POD approval process, BLM requires standard and, in some cases, special site-specific protective measures for design and operation of the proposed project. They also may require establishment of additional monitoring wells.

As part of the APD approval process for FS-administered federal lands, the FS reviews the surface use plan and BLM reviews the drilling plan submitted by a company. Before any surface disturbance can occur on FS-administered federal lands, a company must have a surface use plan approved by the FS District Ranger for on-lease activities, which is part of the APD that must be approved by the BLM Field Manager. A special-use permit is issued by the FS to manage off-lease activities on FS-administered federal lands. On-lease production facilities on federal lands and/or federal minerals are authorized by APDs or Sundry Notices.

After the FS and BLM receive the NOS or APD and before approval, an onsite inspection is made of the proposed drilling locations, access roads, and all other potentially disturbed areas. Agency personnel and company representatives attend the inspection to determine site-specific conditions for approving the APD. As part of the APD approval process, the FS and BLM require standard and, in some cases, special site-specific protective measures for design and operation of the proposed project. The FS may also require additional baseline information on water resources or the establishment of additional monitoring wells.

The U.S. Army Corps of Engineers (COE) authorizes activities that would impact navigable waters and waters of the U.S. through individual permits or nationwide permits for categories of activities, and also receives pre-construction notification of activities. "Waters of the U.S." is a collective term for all areas subject to regulation by the COE under Section 404 of the Clean Water Act. The COE will require a permit when dredge or fill activities are planned in waters of the United States. On June 20, 2000, the COE issued General Permit 98-08 for the discharge of fill material associated with oil and gas exploration and development activities on both private and public lands in the State of Wyoming. A February 19, 1998 letter describing COE jurisdictional areas, regulated activities, and permitting requirements in relation to CBM production activities in northeastern Wyoming is included in Appendix A.

The EPA has the authority to set permit limits, mitigating measures, monitoring requirements, and maximum allowable emission rates for mobile sources (including coal trains). New federal regulations on regional haze require reductions in haze over time.

State of Wyoming

The AQD of the WDEQ enforces U.S. and Wyoming Air Quality Standards and Regulations, and authorizes the construction and operation of stationary compression facilities. A Section 21 permit application is required prior to the construction, modification, or operation of any site, equipment, source, facility, or process that may cause or increase the emissions of an air contaminant into the atmosphere. Emissions from all stationary sources and monitoring activities for these sources are regulated by the WDEQ. The WDEQ has the authority to set permit limits, mitigating measures, monitoring requirements, and BACT for stationary sources.

WOGCC and the WSEO have written construction standards for setting water wells including CBM wells. The construction standards are listed as additional conditions and limitations to the WSEO permit.

Local Government

Construction within the City of Gillette, use of existing rights-of-way and easements dedicated or owned by the City, or discharge of water within the city limits into the City's storm drainage system would require permits. Additionally, the City of Gillette has noise ordinances that could affect drilling or construction within the jurisdiction. Similar permits likely would be required for the proposed project from the affected counties of Campbell, Sheridan, Johnson, and Converse and the City of Wright.

Gillette currently has existing regulations that limit the drilling of water, oil, conventional gas, and CBM wells to lands zoned agricultural or industrial within the city limits. The city is currently considering new regulations that would preclude the drilling of wells anywhere within 460 feet of the city limits.

PUBLIC PARTICIPATION

The Council on Environmental Quality (CEQ) regulations require agencies to make diligent efforts to involve the public in preparing and implementing NEPA procedures (40 CFR 1506.6). Informal scoping was conducted through a direct mail process and a public meeting. The mailing list included landowners, business groups, environmental groups, and other interested members of the public.

A public scoping meeting for the Wyodak Coal Bed Methane EA was held on April 11, 2000 at the Tower West Lodge in Gillette, Wyoming. A total of 126 people registered at the meeting. Comment forms were distributed among the attendees and the public was asked to use the form to document their comments and to provide an address if one wanted to receive a copy of the EA. Public scoping comments were accepted through May 12, 2000. The BLM Buffalo Field Office received 103 forms; written comments were provided on 42 of the forms, the remaining 61 requested a copy of the EA.

All substantive comments the BLM received during the public scoping period have been used to direct the scope and analysis of this EA. The following is a bulleted listing of the issues by topic that was compiled from the comments received from the public:

Surface Water Discharge:

- Erosion due to discharge into drainages
- Flooding potential
- Effects on areas where spreader dikes have eliminated stream channels
- Disruption of grazing patterns
- Discharge rates are variable and different than those predicted in prior NEPA documents
- Water quality
- Sodium Adsorption Ratio
- Effects on uranium development
- Effects on coal mine surface water diversions
- Cumulative effects
- Wasting of water
- Effects to Keyhole Reservoir and the Belle Fourche River

- Effects on water quality and quantity on Crook County
- Effects of changes in turbidity in the Powder River on fish such as the sturgeon chub

Aquifer Depletion:
- How are wells and springs being affected
- Recharge rate
- Wyodak EIS ground water model is not accurate
- Effects of re-injecting the produced water
- Drawdown effects upon the aquifer

Methane Migration:
- Is methane being released from the soil surface?
- How far is gas migration occurring in the coal seam? How significant is drainage between producing wells?

Resource Management Plan (RMP) Conformance:
- Is the action in conformance with the Buffalo Field Office RMP?

Air Quality:
- Dust from construction and operations
- Vehicle emissions
- Emissions from compressor stations
- Leasing conflicts between coal and oil and gas
- A need for coordinated water management between the coal mines and CBM produced water above the mines
- A need for a conflict resolution strategy where CBM and coal mining are in conflict

Well Spacing:
- Well spacing of 40 and 80 acres is too close
- Unitizing should be considered throughout the basin

Underground Fires:
- Potential for spontaneous combustion in the coal seam

Ground Disturbance:
- Power line placement
- Habitat fragmentation
- Noise

Wildlife:
- Effects to sensitive, threatened and endangered species
- Effects to wildlife from increased vehicular activity

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Weed Dispersion:
- Introduction and spread of weeds

Roads:
- Damage caused by heavy equipment
- Creation of two track roads

Heritage Resources:
- Downstream effects to historic properties on federal and private ownership

Economic Effects:
- Effects upon landowners due to potential of higher water well pumping costs, and loss of grazing lands
- Loss of State portion of federal royalty

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CHAPTER 2
ALTERNATIVES

INTRODUCTION

The Proposed Action (PA) considers drilling federal CBM protective wells in the Wyodak project area to partially resolve the problem of methane drainage of the federal mineral estate by producing CBM wells located in adjacent state and fee mineral estate and coal mine dewatering operations and associated methane venting. The venting or loss of methane to the atmosphere from surface coal mining operations is caused by 1) wells drilled into the coals and pumped by the coal mines to remove the water in the coal seams ahead of overburden excavation and 2) exposure of the coal to the atmosphere by surface coal mining operations. The PA would involve the drilling of a maximum of 2,500 federal protective wells and production from approximately 1,425 of the 2,500 wells.

A No Action Alternative was considered in the Wyodak EIS, the NEPA analysis to which this Wyodak Drainage EA is tiered. The Approved Project for the Wyodak EIS, as documented and approved in its Record of Decision, represents the BLM's current management practices and levels for CBM development. As the continuation of current management practices and levels of development have been previously analyzed in the Wyodak EIS as Alternative 1 (the Approved Project), the No Action Alternative has been eliminated from further analysis in the Wyodak Drainage EA. Also, the BLM does not have a discretionary decision regarding whether federal protective wells would be allowed (43 CFR 3162.2). In addition, other alternatives that were considered but not analyzed in detail, are discussed below.

PROPOSED ACTION

The drilling of the proposed 2,500 federal protection wells would occur within the 2,317,000-acre Wyodak project area. The total project life, including production, is expected to be less than 10 years. The estimated initial development period (drilling phase) is projected to be 15 months. APDs for federal protective wells would be approved by the BLM. Proposed well sites and associated facilities including roads, pipelines, and production facilities would result in the total disturbance of about 3,450 acres or about 0.15 percent of the 2,317,000-acre project area.

The producing 1,425 protective wells would capture federal CBM that would otherwise flow toward adjacent wells producing from state and private mineral estate. For the purpose of this analysis, the amount of disturbance projected for this PA is based on the amount of actual existing disturbance compiled on a per well basis. No additional emissions from gas compression beyond that analyzed in the Wyodak EIS are anticipated. Emissions levels are anticipated to be less than those analyzed in the Wyodak EIS due to lower permitting levels for gas-fired compressor engines being required by the WDEQ.

Proposed construction, operations, and decommissioning and rehabilitation of proposed facilities that would occur with implementation of the PA include:

- Access roads for drilling operations
- Drilling operations
- Well production facilities
- Electrical distribution lines
- Power generation
- Central gathering and metering facilities
- Gas gathering system
- Produced water gathering pipeline system and discharge facilities
- Gas high-pressure delivery pipelines
- Pipeline compression

BLM measured actual disturbance from a representative sample (approximately ten percent) of the 1,063 federal wells permitted through October 26, 2000. The disturbance included wells, access roads, pipelines, and central gathering and metering facilities. Total disturbance averaged 1.38 acres per well. Disturbance acreages for those new facilities, that would be constructed and operated as part of the PA, and that would contribute to the 1.38-acres factor are:

- 0.3 acres of long-term disturbance for up-graded roads;
- 0.33 acres of long-term disturbance for two-track roads;
- 0.62 acres of short-term disturbance for pipeline construction; and
- 0.13 acres of long-term disturbance for well and central gathering and metering facilities.

Applying the 1.38-acre factor to the 2,500 federal protective wells, a total of 3,450 additional acres of disturbance is projected from implementation of the PA over the 15-month period. Disturbance over the 15-month drilling/construction period beginning December 2000 for the PA, in combination with current and projected disturbance in the Wyodak project area, is projected to total 17,251 acres. An estimated 12,501 wells would be drilled by the end of February 2002. These drilled wells would consist of the 2,500 new federal protective wells, about 2,824 new state and fee wells, and 7,176 existing wells in the Wyodak project area. Of the 2,500 federal wells drilled, an estimated 1,425 would produce over the 15-month period.

The hydrologic monitoring and mitigation requirements developed and approved in the Wyodak EIS would continue to be followed during the drilling and production of the federal protective wells. Under the PA, site-specific project design features would be required at the APD/POD level of analysis.

Road Access for Drilling Operations

Access to drill locations from the existing road network already in place on federal, state, and private lands would be provided primarily by two-track roads traversing over natural terrain and along pipeline rights-of-way whenever feasible. Travel on two-track roads would be rescheduled or postponed during infrequent periods of wet weather when vehicular traffic could cause rutting. Well access roads would be maintained in an undisturbed, two-track status, unless road upgrades are needed to alleviate safety concerns,

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environmental issues or access difficulties. Gravel or scoria may be applied in problem areas. Troublesome areas, such as stream drainage crossings, low water crossings, and rough topography would be upgraded as the need arises. In less rugged terrain, little earthwork is anticipated for well access road construction.

In more rugged terrain, BLM experience to date has shown that construction of a rough well access road to the drill location using cut and fill construction techniques may be necessary an estimated ten percent of the time. Surface disturbance associated with crowning and ditching (normally required by BLM's general policy on design and construction of oil and gas well access roads) would occur only as required for well access roads traversing steeper terrain or rough, broken topography, or in other exceptional site-specific circumstances. Use of cut and fill construction techniques for well access roads may disturb up to 1.8 acres per well located in difficult terrain. Roads not needed for production would be reclaimed, as needed, as soon as practical after the conclusion of drilling. Roads needed for production may be upgraded, as needed, to ensure safe, environmentally-sound year-round access. At the conclusion of the project, roads and culverts that improve access to livestock pastures or calving areas, cultivated fields, ranch buildings, or other areas could be left in place with surface owner concurrence. All roads no longer needed would be reclaimed.

Drilling Operations

Typically, drilling operations would be confined within an 100 feet by 100 feet well site area that requires no pad construction, i.e., is not leveled and is not cleared of vegetation. The use of cut and fill construction techniques to level work areas would be limited to areas where the land surface is too steep to allow the drill rig to set up over natural terrain. In areas of heavy vegetation or brush, mowers or brush hogs are used to clear vegetation off of the drill site area. In areas where limited cuts and fills are necessary, vegetation and soils may be disturbed or removed. Use of cut and fill construction techniques for well sites may be necessary an estimated ten percent of the time and may disturb up to 0.25 acre per well that is located in difficult terrain. Areas disturbed, but not needed for production, would be reclaimed as soon as practical after the conclusion of drilling. At the conclusion of the project, all disturbed areas no longer needed will be reclaimed.

A mobile drilling rig would be driven to the well site and erected. Typically, a truck-mounted shallow well drilling rig would be used to drill CBM wells. Additional equipment and materials needed for drilling operations, including water, would be trucked to the well site. The proposed project would require approximately 8,000 gallons (or 0.03 acre-feet) of water per well for cement preparation, well stimulation, dust control, and possibly drilling (non-toxic drilling mud is required to handle certain downhole conditions). Native drilling mud and bentonite are normally used for fresh water drilling. As hole conditions dictate, small amounts of polymer additives and/or potassium chloride salts may be added for hole cleaning and clay stabilization.

The drill rig typically would be set up over natural terrain. A temporary mud pit approximately six feet deep, ten feet wide, and up to thirty feet long, would be excavated within each well site area used during drilling and completion operations, and then allowed to dry before being backfilled and reclaimed. The pits would be fenced on three sides during drilling operations, with the fourth side fenced immediately upon rig release. Each producing well would be drilled to a depth of 350 feet to 1,200 feet or deeper, and would have steel casing cemented from the top of the coal seam to the surface. The well control system would be designed to meet the conditions likely to be encountered in the hole and would be in conformance with BLM and State of Wyoming requirements.

The drilling and completion operation for a CBM well normally requires approximately seven to 15 people at a time, including personnel for logging and cementing activities. Each well would be drilled within a period of one to three days. In preparation for production of gas from a drilled, cased, and cemented well, a well completion program may be initiated to stimulate production of gas and to determine gas and water production characteristics. A mobile completion rig similar to the drill rig may be transported to the well site, erected, and used to complete a well. Completion operations are expected to average one to three days per well. Methane may be vented and water temporarily discharged for a very short period of time during testing to determine whether wells will be produced. Once determined to be productive, wells would be shut-in until discharge points, pipelines and other production facilities are permitted and constructed.

Well Production Facilities

If a well is productive, a very small part of each well site, represented by a square area with perhaps five or six feet on each side of the square, would be leveled to install wellhead facilities. A weatherproof covering will be placed over the wellhead facilities. No additional structure would be constructed at the well site for gas-water separation facilities. A downhole pump typically would be utilized to produce water from the uncased open hole interval located below the steel production casing. Methane gas would flow to the surface using the space between the production casing and the water tubing. No pumpjacks would be located at the wellheads. The long-term surface disturbance (less than ten years) at each protective well location where no cut and fill construction techniques are utilized is likely to encompass a negligible area, much less than 0.1 acre. The long-term surface disturbance at each productive well location where cut and fill construction techniques are utilized is likely to encompass approximately 40 feet by 80 feet, or approximately 0.1 acre. Disturbed federal well site production areas typically would not be fenced or otherwise removed from existing uses.

Pipeline trenches for well gathering lines are expected to disturb temporarily on average a 14-foot wide corridor that would be reclaimed as soon as practical after construction is completed. Trenches would be constructed along the two-track well access roads wherever possible. Separate gathering lines, averaging one quarter to one-half mile long each, would be buried in the trenches and would transport methane gas to central gathering and metering facilities and produced water to discharge points.

At the conclusion of the project, roads, culverts, cattleguards, pipelines, stock watering facilities, or other structures would be left only if a beneficial use is identified by the surface owner. Electrical service would be available where CBM wellhead or central gathering and metering facilities were located, at the

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landowner's expense. Water wells and produced water would be available to the surface landowner, with appropriations, diversion, and storage rights already properly filed with the WSEO. Ponds and reservoirs would continue to store water if surface owners elect to manage the wells and continue pumping water from them. All federally-owned surfaces that contain disturbed areas or facilities that are no longer needed would be reclaimed. All disturbed areas and facilities that are no longer needed and are located on private land also would be reclaimed, unless landowners elect to manage the wells and continue pumping water from them, or desire to keep the access roads intact.

Electrical Distribution Lines

Electricity would be used to power downhole pumps during well development and to initiate and maintain production. Electricity would be routed to well sites and ancillary facilities within the transportation corridor. Direct burial cable would be the preferred method of electrification, unless otherwise impractical. Where feasible, electrical lines connecting the wells and the central gathering and metering facilities would be buried in the trenches excavated for well gathering lines. Overhead electrical lines would be installed along the main access roads or in a more suitable location. All overhead electrical lines would utilize raptor protection designs. At the conclusion of the project, overhead distribution systems not owned by the operators may or may not be salvaged. Operators would reclaim areas and facilities no longer needed.

Power Generation

Both natural gas-fired and diesel engine-powered generators may be used on a temporary basis at individual wells until electrical distribution lines are constructed. Either electrical motors or natural gas-fired reciprocating or microturbine engines would power booster or blower units. Future compressors are anticipated to be natural gas-fired or electrical units.

Central Gathering and Metering Facilities

Typically, gas production from each well would be individually measured and mechanically or electronically recorded at a central gathering and metering facility/building. The siting of production central gathering and metering facilities is tied to the siting of CBM wells, which is accomplished site-specifically at the Application for Permit to Drill/Plan of Development (APD/POD) level of analysis. Gas gathering lines for an average of ten wells would be tied together in a central gathering and metering facilities, where metering for all the wells in that central gathering and metering facility would be done. At the central gathering and metering facility, gas is commingled into the gas gathering system, which transports it to the compressor station. An improved road, averaging one-half mile in length, would be constructed to each central gathering and metering facility and would disturb an area not expected to be wider than 50 feet. Each central gathering and metering facility would disturb approximately 0.25 acre. At the conclusion of the project all disturbed areas and facilities no longer needed would be reclaimed.

Pipelines

Three types of pipelines would be constructed as part of the proposed project:

1. Gas-gathering pipeline systems (low pressure, from wellhead to central gathering and metering facility, and from central gathering and metering facility through trunkline to the compressor station)
2. Produced water-gathering pipeline systems
3. Gas-delivery pipelines (high pressure, from compressor station to existing transmission pipelines)

Reclamation of pipeline corridors would occur as soon as practical after pipeline construction is completed.

Gas-Gathering System

As part of the transportation corridor system linking the wells and ancillary facilities, gas-gathering pipelines and produced water-gathering pipelines would be constructed, placed together in the same trench/ditch, when practical, and buried. Construction and installation of pipelines would occur immediately after well drilling. Access roads typically would follow the pipeline right-of-way, except in a limited number of cases where topography dictates or as surface owners require. Separate gathering lines would transport methane gas to central gathering and metering facilities and produced water away from wells to points where water discharge would occur.

Gas-gathering lines, averaging two miles long, each are expected to disturb portions of a 40-foot wide corridor, and would transport gas from each central gathering and metering facility to a trunkline. Separate trunklines, averaging six miles long each, would disturb portions of a 50-foot wide corridor, and would transport gas to compressor stations.

Produced Water-Gathering System and Discharge Facilities

Based on the BLM's and WOGCC's current projection for increased numbers of wells and their compilation of water production data for existing wells (**Table 2-1**), total water production for 1,425 new producing protective federal wells would be approximately 98,172 acre feet over the 15-month period or about 82,900 acre feet on an annual basis. This estimate is based on the WOGCC's recent compilation of federal and state water production data for existing CBM wells (WOGCC 2000). For the 6-month period of January 2000 through June 2000, the discharge rate from producing wells averaged 11.1 gallons per minute (gpm). Applying this same production rate of 11.1 gpm per well over the same 15-month period to 4,093 existing producing wells (as of November 30, 2000), to a projected 1,611 new state and fee producing wells, and to the proposed production from the 1,425 federal protective wells, water production would total approximately 127,497 acre feet as of February 28, 2002 or about 107,660 acre-feet per year based on the previous 12 months of projected production (**Table 2-1**).

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Table 2-1

Water Production from Existing and Proposed Wells for The Wyodak Drainage Project

Year	Month	No. of Days	No. of Wells drilled/Day[1]	No. of New Wells	Cumulative No. of Wells Drilled	Mean Number of Drilled Wells Producing Water/Gas	Cumulative No. of Producing Wells[3]	Gallons of Water Produced per day per Well[2]	Gallons of Water Produced for the Month	Acre-feet of Water Produced for the Month
1999	December				3256		1857			
2000	January	31	0.5	16	3270	57.0%	1865	15984	82414980	2536
	February	29	16.9	489	3759	57.0%	2144	15984	99821184	3059
	March	31	21.1	654	4413	57.0%	2517	15984	124718368	3827
	April	30	8.9	268	4681	57.0%	2678	15984	128016480	3929
	May	31	5.3	165	4846	57.0%	2764	15984	138057376	4230
	June	30	8.4	252	5099	57.0%	2908	15984	139444480	4279
	July	31	13.9	431	5530	57.0%	3154	15984	156278440	4796
	August	31	13.9	431	5961	57.0%	3400	15984	168462176	5170
	September	30	13.9	417	6378	57.0%	3638	15984	174446207	5353
	October	31	13.9	431	6810	57.0%	3884	15984	182441369	5598
	07-Nov	7	13.9	97	6907	57.0%	3939	15984	44078275	1353
	30-Nov	23	11.7	269	7176	57.0%	4093	15984	150467808	4618
	December	31	11.7	363	7539	57.0%	4300	15984	213056363	6538
	Total	366		4283					1823598326	55928
2001	January	31	11.7	363	7902	57.0%	4507	15984	223323024	6853
	February	28	11.7	328	8229	57.0%	4693	15984	210059679	6446
	March	31	11.7	363	8592	57.0%	4900	15984	242813498	7452
	April	30	11.7	351	8943	57.0%	5101	15984	244581723	7506
	May	31	11.7	363	9306	57.0%	5307	15984	262980937	8071
	June	30	11.7	351	9657	57.0%	5508	15984	264102086	8105
	July	31	11.7	363	10020	57.0%	5715	15984	283198677	8690
	August	31	11.7	363	10382	57.0%	5921	15984	293410336	9004
	September	30	11.7	351	10734	57.0%	6122	15984	293546457	9009
	October	31	11.7	363	11096	57.0%	6329	15984	313629277	9623
	November	30	11.7	351	11447	57.0%	6529	15984	313062366	9608
	December	31	11.7	363	11810	57.0%	6736	15984	332755216	10212
	Total	365		4271					3273262148	100485
2002	January	31	11.7	363	12173	57.0%	6943	15984	344071677	10557
	February	28	11.7	328	12501	57.0%	7129	15984	319076172	9792
	Total	59		690					663087849	20349
	15-months	455		5324					6154923761	127496

Footnotes:

[1] Likwartz 2000 [2] WOGCC 2000

[3] Shaded numbers are actual producing wells from the Coal Bed Production Table.

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Produced water may be discharged from individual wells or collected and discharged at a multi-well central point. All produced water would be discharged only at NPDES permitted points. The State of Wyoming considers discharge of this produced water as a beneficial use. Produced water-gathering pipelines would be constructed along the well access road wherever feasible, from the wellhead to locations where water discharge would occur. Water lines would be placed together in the same trench/ditch as gas gathering lines wherever practical, and buried.

Produced water is expected to be discharged into surface drainages from pipelines that average one half mile in length and disturb portions of a 14-foot wide right-of-way. Some discharged waters may be contained near the discharge point in small impoundments. Operators will be asked to develop water management plans for all well development projects. These plans will address how large volumes of produced water would be managed on a drainage-by-drainage basis.

There is likely to be an average of one water discharge point per three to six CBM wells. Several discharge points may be combined into each NPDES permit within the project area.

Gas Delivery System

Existing high-pressure gas delivery lines connect existing compressor stations with existing transmission pipelines. No additional construction of delivery pipelines is proposed as part of this PA.

The pipeline capacity for the life of the project is estimated to be 1.1 billion cubic feet per day (MMCFD). As the existing capacity of pipelines already in place is reached, the least productive wells are likely to be taken off line until additional pipeline capacity is available. Production must be established before potential additional pipeline locations can be identified for site-specific environmental analysis.

Pipeline Compression

Produced natural gas (methane) under wellhead pressure would move through the low pressure gas gathering system to a compressor station. Typical gathering system line pressure is less than 100 pounds per square inch (psi). Gas arriving at the compressor station would be compressed from line pressure to facilitate transport and introduction of the gas into an existing transmission pipeline.

The use of low horsepower (HP) (380-400 HP) natural gas or electric-powered boosters or blowers has been required to enhance gas flow through certain pipelines. Individual booster compressors would likely be located at some central gathering and metering facilities containing proposed protective wells

Compression of the gas at existing and planned (Wyodak CBM EIS) field compressor stations increases the pressure to an estimated 700 to 1,450 psi. Each existing field compressor station has disturbed approximately 1.5 acres. Each transmission pipeline compressor station has disturbed approximately three acres. Impacts from construction and operation of booster, field, and transmission-line compressors have been addressed in the Wyodak CBM EIS. No additional compressor stations are proposed as part of this PA.

ALTERNATIVES CONSIDERED BUT NOT ANALYZED IN DETAIL

A number of additional alternatives to the PA were considered for the Wyodak CBM Project but were not carried through the full analysis in this EA for various reasons. These alternatives and the reasons they were not considered to be feasible are listed below.

No Action Alternative

A No Action alternative for this EA was not analyzed in detail for the following reasons:

1. The No Action Alternative would be defined as the rejection of all applications for federal wells once the cumulative number of wells approved in the Wyodak EIS has been reached. This level of activity was analyzed in the Wyodak EIS under Alternative 1 (the Approved Project), the NEPA analysis to which this Wyodak Drainage EA is tiered. This restriction only applies to the federal mineral estate. Continued well drilling is anticipated on the private and state mineral estates within the Wyodak project area.

2. The BLM does not have a discretionary decision to make regarding whether federal protective wells would be allowed. An operator's drilling and producing obligations to the BLM on federal leases are described at 43 CFR 3162.2. Operators must drill diligently and produce continuously to protect the federal government from royalty loss resulting from drainage. Under these regulations, a No Action Alternative would not be in compliance with 43 CFR 3162.2.

   Policy and procedures addressing drainage of federal oil and gas resources by wells producing on adjacent or nearby lands are contained in BLM-wide Interim Guidelines on Oil and Gas Drainage Protection(BLM-WO Instruction Memorandum 99-051). The BLM must complete well reviews and administrative reviews to identify potential drainage situations (PDS). The BLM must prioritize drainage cases and take action, ensuring that royalty is not permanently lost, due to unleased lands or the statute of limitations.

3. Leases within the project area contain various stipulations concerning surface disturbance, surface occupancy, and limited surface use. The lease stipulations provide that the authorized representative of the Department of the Interior may impose "such reasonable conditions, not inconsistent with the purposes for which the lease is issued, as the BLM may require to protect the leased lands and environment." None of the stipulations imposed would empower the Secretary of the Interior to deny all drilling activity because of environmental concerns where leases have been issued with surface occupancy rights.

   Provisions that expressly provide Secretarial authority to deny or restrict lease development in whole or in part would depend on an opinion provided by the U.S. Fish and Wildlife Service (USFWS) regarding impacts to endangered or threatened species or habitats of species that are listed or proposed for listing (for example, bald eagle). If the USFWS concludes that the PA and alternatives would likely jeopardize the continued existence of any endangered or threatened plant or animal species, then CBM development, including APDs and related Sundry Notices, may be denied in whole or in part on the affected federal leases.

Restrict Timing on Approval of Federal Wells

This alternative considered slowing the rate of approval of wells over the 15-month time period which would result in an approval of a well number less than the proposed 2,500 wells. The rate at which federal wells are approved could be slowed down, but this action would lead to additional drainage of gas from the federal CBM mineral estate, and would not be in compliance with 43 CFR 3162.2.

Inject Produced Water Underground

Requirement of underground injection to dispose of the produced water was considered as an alternative. Injection requires that the receiving formation be capable of accepting the quantity of water being injected. Injection of large quantities of produced water underground in the PRB is being initially studied as a disposal option, and as yet is not a viable alternative. As studies are still underway, adequate information and evaluations are incomplete and therefore a determination of viability can not yet be made.

Disposal of produced water in Wyoming currently is limited to injection into aquifers exempt from the definition of fresh and potable water. Injection of this water into an exempt formation, as allowed under current regulations, would make water now available and being used for livestock, wildlife, and possibly irrigation no longer immediately available for these uses. Subsequent pumping of this injected water for these beneficial uses may be limited or prohibited due to a potential lessening of quality. Produced water from existing projects has been of relatively good quality. Total Dissolved Solids (TDS) levels have averaged 764 mg/L TDS for CBM water discharges reported to WDEQ (WDEQ 1998), well within Wyoming standards for livestock water.

Storage and retrieval of produced water is being permitted by the state in the Gillette area for supplemental future use by the City of Gillette. The water is being injected and stored in aquifers of the Tullock Member of the Ft. Union Formation. Although preliminary results for injection and storage of this water in the Gillette area have been encouraging where the aquifer has previously been depleted, the Tullock aquifers are not regionally extensive (Rice et al. 2000). Data is not available to determine the capability of the Tullock aquifers and other aquifers to support an injection program for disposal of the produced water in the PRB. The BLM would continue to monitor this storage and retrieval program as a possible means of future disposal of produced water.

In addition, injection into the coal seam could defeat the purpose of removing water from the coal seam to produce methane by re-pressurizing the coal seam and reducing methane availability. Injection of produced water would be detrimental to any producing gas well if it experienced water encroachment from BLM-mandated injection. This would be a violation of the gas producer's correlative rights. Also, injection would require a system of wells and pipelines that would increase the total surface disturbance.

PROGRAMMATIC MITIGATION PLAN COMMON TO THE PROPOSED ACTION

Project design features that will be required, if applicable site-specifically, at the APD/POD level of analysis under the PA are compiled below as a programmatic mitigation plan for CBM development. These mitigating measures also are described in various sections of Chapter 4 of the EA, where they are incorporated within the resource impact analyses. Requirements that are Standard Conditions of Approval for CBM APDs are described in Appendix A of the Wyodak EIS Record of Decision and in Appendix B of this EA. Supplemental Standard Conditions of Approval are presented in Appendix C of this EA. The Buffalo Field Office, (Coalbed Methane Well Application for Permit to Drill and Project Plan of Development Preparation Guide, December 2000), is also used as a guide to avoid or minimize environmental harm.

Geology and Minerals

Inadvertent release to the atmosphere of the methane resource will be controlled through APD conditions of approval that address well control, casing, ventilation, and plugging procedures appropriate to site-specific CBM development plans.

Surface Water

Mitigation measures in the form of water management plans will be developed and applied as a cooperative effort at the APD/POD level of analysis, on a site-specific basis or under a Plan of Development (POD) on a project-level basis (Appendices B and C). This effort will include the agencies with jurisdiction (the BLM, FS, COE, WSEO, WOGCC and/or WDEQ) in consultation with the involved land managers and conservation districts, operators, landowners, and nearby downstream interests, including users of waters and landowners affected by impacts of increased flows on access, ranching, or mining operations. The cooperative efforts of all stakeholders will be necessary in developing water management plans that identify mitigating measures for areas or drainages where high CBM generated flows are or could be impacting existing uses. Some of the measures that could be applied, as appropriate, at each site include:

- Produced water will be dispersed in the upper reaches of drainages through the installation of stock tanks.
- Produced water will be transported to distant discharge points, which could require the use of water disposal pipelines that are more than one-half mile long.
- Produced water will be discharged into existing stream channels, reservoirs, stock ponds, and stock tanks in a manner that will not cause increased or accelerated erosion. This has been done effectively in past CBM projects by using energy dissipaters at discharge points and by discharging into channels that are well developed and large enough to handle the increased flows. Energy dissipation can be

achieved through the use of rock, placement of concrete control structures and/or the establishment of hydrophytic vegetation.

- Discharge points will be located to minimize spring flooding of fields.

- Discharge outfalls will use alternative outfalls for use with irrigation, as agreed upon by operator and landowner or lessee. If discharge water SAR values are not compliant with WDEQ irrigation suitability evaluation criteria, water will require treatment to meet the criteria prior to any discharge or confinement in a compliant non-discharge impoundment.

- To handle total flows with the addition of CBM produced waters, existing downstream culverts on lease will be replaced should flows exceed culvert capacity. New culverts and/or low water crossings will need to be sized to BLM standards for anticipated total flows. Off lease, it is recommended that the operator work with other operators and with surface owners in the same drainage to replace downstream undersized culverts that will be affected by their discharge.

- Discharges will be limited to a volume less than or equal to the naturally occurring mean annual peak flow (which is roughly equivalent to a peak generated by a 2-year, 24-hour storm) and which can be handled by the natural channel under anticipated conditions.

- Local springs will be identified, and construction will be avoided in these areas.

- Discharge into playas will be avoided unless issues related to potential wetland creation, maintenance of discharge facilities, reclamation, and accountability are agreed upon by the operator and landowner or lessee.

- Discharge points will be selected in stable channels or reservoirs away from any significant downstream headcuts or other major erosional features. Outfall design may include discharge aprons and downstream stabilization of channel side slopes to prevent erosion and provide energy dissipation.

- Discharge facilities will be site-specifically designed using best management practices, to accommodate livestock's access to water, to control erosion, and to limit sedimentation.

- Irrigation diversions to increase channel length and in-stream impoundments will be established, as appropriate, and as agreed upon by the operator and landowner or lessee.

- Downstream impoundments may need new or redesigned outlet works in order to handle the steady inflow provided by CBM discharge water.

- As per State of Wyoming effluent limitations and monitoring requirements contained in approved permits, and BLM or FS monitoring requirements contained in approved monitoring plans, volume and water quality parameters will be monitored at discharge sites by CBM producers. Monitoring also will occur at selected stations or downstream points of compliance on the Little Powder, Powder, Belle Fourche, and Cheyenne Rivers and/or their tributaries.

- The areal extent of surface disturbance and the length of time that the area will remain disturbed before interim or final reclamation activities commence will be minimized.

- Interim and final reclamation of all disturbed areas will proceed in a timely manner. Reclamation activities will be conducted during time frames established by federal land management agencies, landowners, and affected interests.

- Reclamation must produce a natural appearance and must be consistent with site conditions, area management standards, and projected uses, as agreed upon by the operator, landowner or lessee, and appropriate state and federal agencies.

- Reclamation will include, as appropriate, recontouring, establishment of desirable, perennial vegetation, stabilization and erosion control of all disturbed areas. Additional measures, such as topsoil conservation, temporary fencing, mulching, or weed control will be utilized, as appropriate, to ensure long-term vegetative stabilization of all disturbed areas. Reclamation standards will be agreed upon by the operator, landowner or lessee, and appropriate state and federal agencies.

- A water management plan must accompany each federal APD/POD and must address all potential CBM development in a watershed area, regardless of surface and mineral ownership (Appendices B and C and BLM Plan of Development Preparation Guide).

- At the discretion of the surface owner, dams can be removed and the impoundment area reclaimed after the produced water is no longer available.

- Design and siting of discharge facilities must be carefully controlled or limited where channels are not stable, armored, or large enough to accommodate the flows that will be anticipated.
- Design and location of discharge points must be carefully controlled or limited or localized flooding may occur with increased frequency and magnitude where channel or basin capacity is insufficient to handle increased flows.

- Potential impacts to spring flow, specially those related to scoria aquifers like the one feeding Moyer Springs, can be analyzed site-specifically, as needed, during review of APDs/PODs or Sundry Notices, and impacts mitigated through the applications of special conditions of approval for drilling or production operations.

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- The feasibility of designing surface water discharge facilities that could prevent increased sediment loads from reaching the affected segments of the Belle Fourche drainage having "water quality limited beneficial uses" will be analyzed site-specifically.

- Timely recontouring and revegetation of disturbed areas will be required to limit runoff from disturbed areas that could cause sediment concentrations in surface waters to rise over present levels.

Groundwater

- A standard agreement has been developed by CBM operators and landowners to monitor and mitigate water well impacts caused by CBM operations.

- The BLM requires compliance with the Hydrologic Monitoring and Mitigation program outlined in the Wyodak EIS ROD.

- As part of the APD/POD approval process, BLM requires standard and, in some cases, special site-specific protective measures for design and operation of the proposed project. They also may require establishment of additional monitoring wells.

Air Quality

- Air quality issues related to stationary sources of air pollution will be addressed in accordance with the authorities of the WDEQ. Air quality issues related to mobile sources of air pollution will be addressed in accordance with the authorities of the EPA. Visibility impairment within federally mandated Class I areas will be addressed in accordance with federal regulations on regional haze. Visibility impairment at other Class I and sensitive Class II areas will be addressed in accordance with the recommendations from interagency and stakeholder coordinating groups.

- At the discretion of the surface owner, and in accordance with permitting decisions made by the WDEQ, compressors and compressor stations should be sited to avoid sensitive surface resources and potential conflicts with other uses.
- Under the regulatory authority of the WDEQ and at the discretion of the landowner and the CBM operator, the implementation cost and effectiveness of electrification of compressors and other BACT will be considered.

- Dust control by watering or other appropriate means may be required on access roads.

Soils

- Accelerated soil loss will be minimized by limiting the following: the removal of vegetation; the leveling of work areas; and the location of wells on slopes that require cuts-and-fills for well pad construction.

- Timely initiation of reclamation and revegetation efforts will be required to effectively and immediately control accelerated soil loss due to either wind or water erosion.

- Road construction that requires cuts-and-fills will be minimized. Pipeline construction also will avoid steeper slopes where possible. Where necessary, erosion control features, such as water bars or other means of diverting flows off sloping pipeline rights-of-way, will be constructed to control increased runoff and erosion.
- Areas of highly erosive soils will be avoided when drill sites, two-track access routes, and pipeline routes are surveyed and staked, in order to substantially reduce the amount of soil loss.

- Soil fertility testing and the addition of soil amendments may be required to stabilize some disturbed lands.

- Surface disturbance will be minimized by using construction equipment that is appropriate to the scope of work.

- Roads will be constructed to the minimum standard needed, so that disturbance to soil and vegetation on each road will be minimized.

Vegetation Resources

- Reclamation and final closure of the proposed operations will re-establish vegetation suitable for forage and wildlife habitat in the disturbance areas.

- Actions that will enhance restoration of vegetation productivity from desirable species include the following site preparation and reclamation techniques: mechanical loosening or roughening of the soil where compacted (discing or ripping); fertilization or soil amendment; seeding to proper depth with desirable species; mulching to retain soil moisture; transplanting containerized plants to speed the establishment of slow-growing species; control of noxious weeds; or temporary fencing to exclude livestock until vegetation is reestablished successfully. These actions will be required, as appropriate.
- Mitigation activities most effective in reducing the potential for decreased vegetation production include timely and well-planned reclamation and effective noxious weed management, avoidance of disturbance within playas (old lake beds), and avoidance of discharge within closed basins, playas, and areas with soils that will be difficult to revegetate. These mitigation activities will be required, as appropriate.

Wetlands

- For any jurisdictional wetlands identified that may be impacted, a detailed mitigation plan will be developed during the APD/POD or Sundry Notice approval process. Federal requirements to replace all impacted wetlands will mitigate this loss, so environmental impacts will occur only during the life of the project (including reclamation).

- The State of Wyoming Department of Environmental Quality, Water Quality Division administers a State Wetland Bank. Landowners have the opportunity to "bank" newly created or expanded wetland areas. While banking provisional wetlands from CBM discharges serves to record the existence or nonexistence of prior non-wetland status, there is no temporary mitigation. Wetlands used for mitigation purposes become jurisdictional and must be maintained in perpetuity. If wetland characteristics are lost due to inadequate hydrology, or other factors, then the banked credit is lost. Banking of wetlands will be considered, as appropriate.

- Mitigation activities most effective in reducing the potential for adversely impacting existing wetlands include: avoidance of discharge within playas and closed basins; avoidance of discharge within or near existing wetlands (if increased discharge volumes or subsequent recharge of shallow aquifers will inundate and kill woody species, especially willows or cottonwoods); and avoidance of disturbance within all delineated or recognized wetlands.

- At the discretion of the surface owner, fencing of wetlands and providing off-site watering for livestock will be used to allow vegetation development and maintenance of water quality in key wetlands. Any fences used should be placed well back from the wetlands to prevent waterbird mortalities and should be constructed to standards that allow big game movement.

- Consideration will be given to having wetlands and ponds built on accessible public lands where recreational users can benefit from the development.

Wildlife

- All power lines will be built to protect raptors from accidental electrocution.

- Power line corridors will avoid wetlands, to the extent possible, in order to reduce the chance of waterfowl hitting the lines.

- At the discretion of the surface owner, several small ponds will be consolidated into one larger pond in order to provide more open water and a longer shoreline at one site, which may be more beneficial to wildlife.

- The appropriate standard seasonal or year-long stipulations for raptors, sage grouse, and big game, as identified by the BLM's Resource Management Plan, will be applied.

- Fences along service roads will be avoided unless absolutely necessary, in order to prevent a maze of barriers to big game movements. Fences will be constructed to standards that allow for easy big game passage, in order to avoid big game entanglements.

Fisheries

At the discretion of the surface owner, several small ponds will be consolidated into one larger pond that may have the characteristics needed to support a fishery.

- At the discretion of the surface owner, reservoirs developed as part of CBM activities will be sited within natural stream courses, to provide benefits to fish and wildlife resources.

- Under the authority of the WDEQ, CBM produced water and receiving waters will be analyzed before wetlands, ponds, or lakes are formed or expanded. Selenium levels that would cause adverse effects in fish or waterfowl should be not be present.

Special Status Species

- Surveys for nesting mountain plovers are recommended if ground disturbance (wells, roads, pipelines, etc.) of the proposed project occurs between May 1 and June 30 on areas identified as being potential habitat by the Wyoming Game & Fish Department in consultation with BLM.

- Special habitats for raptors will be analyzed site-specifically during the review of the APD/POD or Sundry Notices. A minimum disturbance-free buffer zone of one-half mile will be established for all raptors during the nesting season (February 1 through July 31), in accordance with the BLM's Resource Management Plan for the area. Enlarged disturbance-free buffer zones will be established for specific species, as appropriate, at the APD/POD level of analysis.

- Prairie dog towns will be surveyed for the presence of black-footed ferrets if the towns meet USFWS guidelines. Disturbance in prairie dog towns will be avoided or minimized, to protect sensitive species such as the burrowing owl and mountain plover.

- A disturbance-free buffer zone of one-quarter mile is established around a sage grouse lek to reduce the likelihood that proposed drilling and construction activities will disrupt breeding and nesting activities. A seasonal timing restriction will extend outward for another 1¾ miles from the one-quarter mile buffer-free zones applicable during March 1 through June 15.

- At the discretion of the surface owner, native species will be planted to reestablish special habitats.

Cultural Resources

- All areas of proposed ground disturbing activity will be inventoried for cultural resources at the APD/POD or Sundry Notice phase of each action.

- Specific plans for avoidance or data recovery will be recommended for any significant sites within the area of potential effect of the proposed activities.

Land Use and Transportation

- If CBM development activities are proposed in the vicinity of scattered subdivisions near Gillette, site-specific mitigating measures will be developed to minimize the impacts and to resolve conflicts.

- Over the project life, uneconomic and depleted wells will be plugged and abandoned, and the disturbance reclaimed and revegetated to approximate pre-project conditions.

- Reclamation and final closure of the proposed operations will reestablish the land uses of grazing and wildlife habitat in the disturbance areas.

- CBM facilities such as central gathering and metering facilities or compression facilities will be fenced as specified by the BLM.

- Roads and facilities no longer needed will be removed and the affected area will be rehabilitated.

- Where feasible, each access road will be constructed in a transportation corridor that will also include gas and water pipelines, and electrical cables.

Visual Resources

- Gathering lines, water lines, high pressure gas lines and underground electrical cables will be located along road rights-of-way whenever feasible.

- Long-term visual impacts will be minimized by designing permanent structures to harmonize with the surrounding landscape to the extent feasible, recontouring and revegetating disturbed areas no longer needed for operations as soon as practicable, and by reshaping straight edges of clearing resulting from roads, pipelines, well pads, and compression facilities to create irregular or indistinct edges.

- Proposed facility developments on BLM-administered federal surface will be consistent with BLM management objectives for mapped VRM classes.

- All proposed wells and facilities on FS-administered federal surface will be consistent with FS Visual Quality objectives for the Thunder Basin National Grassland. Adverse visual impacts will be minimized through careful location of facilities, minimal disturbance of affected sites, and design of facilities so that they harmonize with the surrounding landscape.

- Use of two-track and existing roads and centralization of gas compression facilities along existing roads will minimize the visual impact of the road network.

- The use of buried power lines to each well, where feasible, will reduce the linear element in the landscape.

- Construction debris will be removed immediately, as it creates undesirable textured contrasts with the landscape.

- Resource protection measures proposed for erosion control, road construction, rehabilitation and revegetation, and wildlife protection will be implemented during the approval of APDs and Sundry Notices. These measures also will mitigate impacts to visual quality.

Noise

- Compressors should be located at least 600 feet from sensitive receptors (residences, schools, medical facilities, and recreation areas). Under current Wyoming law, the WDEQ can only require this mitigation to occur if municipal or county land use plans address siting of noise emitters.

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CHAPTER 3
AFFECTED ENVIRONMENT

INTRODUCTION

The project area for the affected environment encompasses approximately 3,600 square miles or 2,317,000 acres. This area coincides with the project area analyzed in the Wyodak EIS.

The description of the affected environment focuses primarily on air quality, hydrologic, and hydrogeologic conditions in the project area because it is believed these aspects of the environment are the most likely to be affected by the proposal. Other aspects of the environment have been discussed in the Draft and Final Wyodak EISs (USDI BLM 1999a, b), Buffalo RMP (USDI BLM 1985), the BRA Oil and Gas EA (USDI BLM 1980a), the West Rocky Butte Coal Lease Application EIS (USDI BLM 1992a), the Jacobs Ranch Coal Lease Application EA (USDI BLM 1991), the West Black Thunder Coal Lease Application EA (USDI BLM 1992b), the North Antelope/Rochelle Coal Lease Application EA (USDI BLM 1992c), the EA for American Oil and Gas' Marquiss CBM Project (USDI BLM 1992d) the Lighthouse CBM Project EA (USDI BLM 1995c), the Eagle Butte Coal Lease Application EA (USDI BLM 1994a), the Antelope Coal Lease Application EA (USDI BLM 1995a), the Gillette North CBM Project EA (USDI BLM 1996a), the Gillette South CBM Project EIS (USDI BLM 1997a), the North Rochelle Coal Lease Application EIS (USDI BLM 1997b), the Powder River and Thundercloud Coal Lease Application EIS (USDI BLM 1998b), the environmental analysis project record for the Horse Creek Coal Lease Application (USDI BLM 1998c), the Land and Resource Management Plan for the Medicine Bow National Forest and TBNG (USDA FS 1985), and the Oil and Gas Leasing EIS for the TBNG (USDA FS 1994). There is additional detailed information on wildlife, soils, vegetation, air quality, surface water, groundwater, and cultural resources within the existing coal mine permit areas and associated buffer zones in original mining permit applications, in subsequent mining permit amendments and renewals, and in annual mine reports for the Buckskin Mine, Rawhide Mine, Eagle Butte Mine, Dry Fork Mine, Ft. Union/Kfx Mine, Wyodak Mine, Caballo Mine, Belle Ayr Mine, Cordero-Rojo Mine complex (formerly the Caballo Rojo and Cordero Mines), Coal Creek Mine, Jacobs Ranch Mine, Black Thunder Mine, North Rochelle Mine, North Antelope Mine, Rochelle Mine, and the Antelope Mine. All of these coal permit documents are required by state law. They are submitted to and approved by the WDEQ, Land Quality Division (LQD), and are available for viewing at the WDEQ offices in Sheridan and Cheyenne.

Several critical elements of the human environment would not be affected by the project or are not known to be present within the project area. Consequently, they are not discussed further. These critical elements are areas of critical environmental concern, prime or unique farmlands, hazardous wastes, wild and scenic rivers, wilderness, and paleontological resources.

LOCATION

The project area for the Wyodak Drainage EA is located in northeastern Wyoming, within Campbell County and small portions of Converse, Johnson, and Sheridan Counties. All of the project area has been analyzed in previous environmental impact assessments for CBM projects. These assessments include the Wyodak EIS, Gillette North EA, and Gillette South EA.

The project area is a long rectangular area extending up to 110 miles in a North-South direction from the Wyoming-Montana border, and covering nearly 40 miles in an East-West direction at some locations. The eastern extent is defined by the areas of major coal development in eastern Campbell County. Gillette, Wyoming is located adjacent to the eastern boundary of the project area, just outside the area's eastern limit. Wright, Wyoming is located in the southern portion of the project area. Wyoming Highway 59 passes through the project area, connecting Interstate 90 at Gillette with Interstate 25 near Douglas, Wyoming.

PHYSIOGRAPHY AND TOPOGRAPHY

The project area is a high plains area within the eastern portion of the Powder River Basin (PRB). This basin is bounded by the Black Hills on the east, the Big Horn Mountains on the west, the Hartville Uplift on the south, and the Yellowstone River on the north. The western half of the project area includes the Powder River Breaks. Landforms of the area consist of a dissected, rolling upland plain, with low relief, broken by low red-capped buttes, mesas, hills, and ridges. Elevations range from 3,600 to 5,000 feet above sea level. The major river valleys have wide, flat floors and broad floodplains. The drainages dissecting the project area are incised and typically ephemeral or intermittent. Thus, they are not permanent or year-round water sources. Underground coal seams are important aquifers in many parts of the project area, feeding springs and seeps. Drainage catchments and open basins are separated by scoria hills, ridges, and buttes.

The project area forms a low divide among several drainage systems. Northwestern and western portions of the area, generally those areas west of Highway 50 and north of Highway 387, are drained by the north-flowing Powder River. The northeastern portion of the project area is drained by tributaries of the Little Powder River. The area east of Highway 50, located between the communities of Gillette and Wright, is drained by the Belle Fourche River and its tributaries. The areas south and east of Highway 387 are drained by the Cheyenne River.

GEOLOGY AND MINERAL RESOURCES

The project area is located along the eastern limb of the Powder River structural basin. The portion of the PRB situated within Campbell County is one of the major mineral development areas in North America. Coal, oil, gas, and uranium have been the principal resources extracted from the basin.

This north-south trending syncline was formed about 60 million years ago during the Laramide Orogeny (episode of mountain-building), which occurred in the early Tertiary Period of geologic time (WGS 1996). Basin sediments were derived from the Bighorn Mountains to the west, the Laramie Mountains and Hartville Uplift to the south, and the Black Hills to the east. Geologic formations exposed at the surface within the project area include: Quaternary alluvial deposits, clinker, and the White River, Wasatch, and Fort Union Formation (Fms) (**Table 3-1**) (WGS 1987 and 1990).

Table 3-1
Generalized Description of the Shallow Geology Within the Wyodak CBM Project Area

Formation	Description	Aquifer Characteristics
Alluvium	Unconsolidated and poorly consolidated Quaternary alluvial deposits of silt, sand, and gravel. Underlies floodplains and low terraces. Thickness generally less than 50 feet (WGS 1974).	Fine-grained alluvium usually yields a few gallons per minute; more in coarser deposits.
Clinker	Reddish to black baked and fused rock formed by natural burning of coal seams within past few million years. Caps, hills and ridges. Thickness is up to 200 feet.	Highly fractured clinker has very high transmissivities and specific yields. Generally unconfined. Contact springs at base of clinker yield up to 400 gpm.
Wasatch	Arkosic sandstone, siltstone, shale, and conglomerate lenses with many coal beds present in the lower part (WGS 1990). It dates from the Eocene epoch of the Tertiary period (37 to 58 million years ago). This formation is found at the surface throughout most of the project area south of Gillette as well as the area northwest of Gillette.	Discontinuous lenticular sands, fine- to medium-grained; generally supply provides adequate quantities for stock use.
Wasatch/Fort Union Contact		
Upper Fort Union (Upper Tongue River/Wyodak Coal)	Coal, 50 to 100 feet or more thick.	Continuous, fractured coal seam.
Upper Fort Union (Lower Tongue River) and Lebo	Interbedded sandstones, siltstones, shales, and coals.	Sands fine- to medium-grained; Lebo is a leaky confining layer between Upper and Lower Fort Union.
Lower Fort Union/ Tullock	Interbedded sandstones, shales, and coal.	Sands somewhat coarser than Upper Fort Union; sand at base of Fort Union (Tullock) is good producer and has regular industrial use.

Unconsolidated and poorly consolidated alluvial deposits of Quaternary age (less than 2 million years old) are found in the floodplains and low terraces of the larger streams draining the area (WGS 1990). These deposits are comprised of silt- to gravel-sized material that has been eroded from siltstone, sandstone, limestone, conglomerate, and clinker within the PRB.

The natural burning of coal beds in the PRB over the past few million years has consumed billions of tons of coal and has baked and melted the overlying bedrock. This metamorphosed rock, known as clinker, presently covers about 1,600 square miles of the PRB in both Wyoming and Montana (Coates and Heffern 2000). A wide variety of clinker rock types is produced, depending on lithology of the parent rock, temperature and duration of heating, and degree of oxidation. Clinker can vary from red brick-like baked rock to gray ceramic porcellanite to black vesicular paralava. Being more erosion-resistant than unbaked rock, clinker caps hills and ridges, such as the Rochelle Hills along the eastern edge of the study area.

The White River Fm is composed of tuffaceous claystone and siltstone with conglomerate lenses near its base (WGS 1987). It dates from the Oligocene Epoch of the Tertiary Period (24 to 37 million years ago). Within the project area, this formation is only found capping the Pumpkin Buttes, located in southwestern Campbell County.

The Wasatch Fm is composed of interbedded arkosic sandstone, siltstone, shale, and conglomerate lenses, and also contains many coal beds (WGS 1990). It dates from the Eocene Epoch of the Tertiary Period (37 to 58 million years ago). This formation occurs at the surface throughout most of the project area.

The Fort Union Fm is composed of interbedded sandstones, siltstones, shales, claystones, and coal, with minor conglomerate and limestone lenses. It dates from the Paleocene Epoch of the Tertiary Period (58 to 66 million years ago)(WGS 1990). Fort Union sediments were deposited by north-flowing braided, meandering and anastomosed streams, and swamps in the basin center, and by alluvial fans at the basin margin (Flores et al. 1999). This formation occurs throughout the project area and is exposed at the surface within the northern third of the area and along the eastern margin of the area. The Fort Union has been divided into three members: Tongue River, Lebo, and Tullock. The Tongue River is the uppermost member and is rich in sandstone and coal. The middle Lebo member has a high percentage of shale, and the lowest Tullock member is dominated by sandstone.

The upper part of the Tongue River member contains the Wyodak coal zone. The Wyodak is also known as the Wyodak-Anderson or Anderson-Canyon coal zone in the project area (USGS 1986a) and may also be correlated in a corkscrew fashion with lower coal zones such as the Big George, Wall, and Pawnee (Goolsby and Finley 2000). The Wyodak zone may contain as many as 11 distinct coal beds within an interval as much as 900 feet thick. These beds merge in places into a single bed as much as 200 feet thick. Several less significant coal zones, such as the Felix, Wall, and Pawnee, lie above and below the Wyodak. Regionally, the different coal zones merge, split, and pinch out laterally, forming a shingled or overlapping pattern; locally they display a zigzag pattern (Flores et al. 1999, Flores 2000). Goolsby and Finley (2000) go a step further and postulate that the major Fort Union coals in the eastern PRB of Wyoming are part of a single lithologic unit that was continuously deposited through late Paleocene time in a migrating depositional center. In the project area, the Wyodak zone occurs at depths ranging from 200 to 1,000 feet below the surface, increasing in depth from east to west; total thicknesses of coal beds in this zone commonly range from 50 to 150 feet.

The Wyodak is the primary target zone for the proposed CBM wells associated with this project, although in places the Felix, Big George, Wall, and other zones are being developed. The methane contained in this coal is present in a free state, adsorbed on interior pore surfaces and micropores of the coal matrix, and dissolved in water contained within the seam. Reducing the hydrostatic pressure on the coal seam by pumping off the water enhances the release and production of methane previously trapped in the coal matrix as well as gas dissolved in the water.

The Wyodak coal is mined extensively in open pit mines located just east of the project area. The PRB contains some of the largest accumulations of low-sulfur subbituminous coal in the world. The coal and its associated clinker are exposed at the surface in north-south oriented outcrops along the eastern boundary of the project area (USDI BLM 1985). The coal occurs at depth, below the surface, throughout the rest of the project area. This coal is valued for its clean-burning properties.

Exposures of clinker are associated with coal outcrops, marking the locations where coal has burned in place. Burning coal in the PRB is a natural process that has been going on for the last few million years, since erosion began to expose the coal beds (Coates 1991). It has long been recognized that spontaneous combustion, range fires, forest fires, and lightning cause coal outcrops to burn naturally, producing clinker (Rogers 1918). The U.S. Bureau of Mines conducted fire control projects on 39 natural and manmade coal fires in the PRB between 1949 and 1977 (Kim and Chaiken 1993).

Clinker exposures in the eastern PRB occur primarily along the eastern boundary of the project area in the Rochelle Hills and within the Powder River Breaks in the northern portion of the project area and are associated with the natural burning of the Wyodak coal zone. Burning of the Felix coal zone in the Wasatch Fm has produced a number of isolated clinker-capped buttes and ridges along Highway 59 between Gillette and Wright. As coal burns, the burn front advances into the hillside until, with increasing depth, fissures in the overburden above the coal fail to reach the surface. At that point, the supply of air is cut off, extinguishing the fire (Coates and Heffern 2000, Heffern and Coates 2000).

Studies by the former U.S. Bureau of Mines (Kim 1977, Kim and Chaiken 1993, Kuchta et al. 1980) and by Goodarzi and Gentzis (1991) describe reactions that can raise the temperature of coal to the ignition point. Two exothermic processes - wetting and oxidation - contribute to spontaneous heating. Lower rank coals, such as the subbituminous coals in the PRB, are especially prone to spontaneous combustion. When moist air comes in contact with dry coal, the heat of wetting reaction releases heat and raises the temperature of the coal. The rise in temperature caused by this physical reaction can be enough to accelerate the chemical process of oxidation in the coal. This critical "oxidation acceleration" temperature is as low as 35°C. for lignite and subbituminous coals. After this temperature is reached, oxidation and heating quicken due to chemical changes and release more volatile gases such as carbon dioxide and methane, until ignition occurs at 400° to 500°C. Sarunchi (1991) noted that when water levels drop in abandoned mines with unconfined coal aquifers, oxidation increases and the self-heating of coal accelerates and combustion occurs. In summary, conditions favoring spontaneous combustion include: 1) low rank coal, such as in the PRB, with a high percentage of reactive vitrinite and exinite macerals; 2) fresh, unweathered coal; 3) fine particle size of the coal creating a high surface-to-volume ratio; 4) a large enough mass of such finely divided coal to minimize heat loss by radiation; 5) exposure of coal to oxygen above the water table; 6) moist air promoting heat of wetting; and 7) a high rate of air flow to provide oxygen.

The northern San Juan Basin (SJB) in southwest Colorado has experienced coal fires, methane seeps, and dead and stressed vegetation at a number of locations since CBM development began a decade ago (USDI BLM San Juan Field Office 2000). What is the potential for coal fires and methane migration or seepage within the PRB? Although some similarities exist between the two basins, there are significant differences.

1. Basin pressurization and regional groundwater flow - The PRB is not an overpressured basin, as is the SJB. Groundwater flow in the PRB coal aquifer is generally downdip to the northwest, toward the center of the basin (USGS 1986b), rather than updip toward the outcrop.

2. Recharge from clinker - Unlike the SJB where there is little groundwater recharge or clinker at the coal outcrop, extensive deposits of porous clinker occurring in the PRB east of the coal mines trap rainfall and snowmelt and help recharge the coal aquifer to the west (USGS 1988, Peacock 1997, Heffern and Coates 2000).

3. Coal characteristics - The subbituminous coal in the PRB is more prone to spontaneous combustion than the bituminous coal in the SJB (Kim 1977). Bituminous coal generally has better-developed cleat systems than subbituminous coal; hence, more avenues for water and methane to migrate. Subbituminous coal has higher water content than bituminous coal.

4. Methane characteristics - The natural gas from coal in the SJB is largely thermogenic, generated at depth from the high temperatures and pressures associated with burial, and is "wet" - containing some higher weight hydrocarbons such as ethane in addition to methane. In the PRB, the natural gas from coal is biogenic, derived from bacterial breakdown of the coal, and is "dry" - overwhelmingly methane with little or no higher weight hydrocarbons (Gorody 2000).

5. Gas pressures - Virgin reservoir pressures in SJB coals (1000 to 1500 psi) are over an order of magnitude higher than those for PRB coals (40 to 50 psi). Producing pressures are 300 to 600 psi for SJB coals but 5 psi or less for PRB coals.

6. Basin structure - In the SJB outcrop area, where methane seepage occurs, it is confined to a much smaller area. Strata dip 20 to 50 degrees toward the basin in the northern SJB but only 1 to 2 degrees in the eastern PRB. Therefore, methane seepage may be more concentrated in the SJB than in the PRB. The SJB also is more highly deformed than the eastern PRB and contains more faults and fractures that could serve as conduits for methane migration. Aubrey et al. (1998) also note the lack of substantial caprock in the SJB that would limit the flow of groundwater or methane migration.

7. Experience in existing mines - Mine fires are common in piles of coal fines at the base of highwalls in PRB mines and are regularly extinguished. Since CBM development began, mine inspectors have not noted a significant increase or decrease in the number of fires in coal pits located east of the Marquis and Lighthouse CBM projects where, to date, groundwater drawdown due to CBM development has been greatest. Moreover, the frequency of coal fires in these pits is similar to that for coal pits located some distance from CBM development.

8. Direction of recharge from streams – In the northern SJB, streams flow south from the San Juan Mountains into the basin. In the PRB of Wyoming, many streams (including the Belle Fourche River, Cheyenne River, and Little Powder River) have their headwaters within the basin and flow east out of the basin. This may affect the amount of groundwater recharge into the respective basins.

Methane seepage can occur naturally in the vicinity of near-surface coal seams (Glass et al. 1987, Jones et al. 1987). The potential for methane migration within the PRB is not limited to areas containing near-surface coal seams (areas near the coal outcrops along the eastern margin of the project area) or areas where dewatering has occurred. Methane migration potentially could occur at widespread locations within the PRB, as methane can migrate long distances along naturally-occurring joints or fractures in rocks, as well as up poorly-completed wells and drill holes. Whether methane seepage could accelerate the natural process of coal combustion at the outcrop is an unresolved question.

Most of the coal in the project area is federally-owned. These federal coal lands are within the Wyoming portion of the decertified Powder River Federal Coal Region (USDI BLM 1996c). There are 16 active coal mines or mine complexes adjacent to the project area (Map 1-2). In 1999, 320 million tons of coal were produced from mines located in the vicinity of the project area - almost a third of total coal production in the United States (WSGS 2000).

Conventional oil and gas exploration and production also occur within the project area and other portions of the PRB. As of 1996, there were 44 fields and 407 wells producing conventional oil and gas (Dwight's 1996). Currently producing formations underlying the Wyodak coal zone include several from the upper Cretaceous: Parkman Sandstone, Sussex Sandstone, Teckla Sandstone, Niobrara Shale, and Turner Sandstone. Producing formations from the lower Cretaceous are the Mowry Shale, Muddy Sandstone, and Dakota Sandstone. The Pennsylvanian/Permian Minnelusa Fm is stratigraphically the lowest (oldest) producer.

Drilling for CBM in the PRB began in 1987 (WOGCC 2000). As of November 30, 2000, a total of about 7,176 wells have been drilled; approximately 4,093 of these wells are in production.

The southwestern portion of the project area lies within the Pumpkin Buttes uranium mining district (WGS 1974). The greatest tonnage of uranium mined within Campbell County was in 1960. Surface deposits in the Pumpkin Buttes area were depleted in the 1960s. Significant uranium reserves remain in subsurface roll fronts in sandstone. These uranium-bearing sandstones lie in the Wasatch Fm, above the Wyodak coal zone. One in-situ mine in the district, the Christensen Ranch Mine, produced 507,000 pounds of yellow cake in 1997 (WGS 1999). It is located immediately west of the project area in T45N, R77W. Although there are currently no active mines or plans for new operations within the project area (WGS 1985 and 1999), in-situ (in place) solution leaching of subsurface uranium is occurring adjacent to the project area. Three active in-situ operations are located in Converse and Johnson Counties.

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WATER RESOURCES

Surface Water

The project area drains into the Little Powder River, Belle Fourche River, Upper Cheyenne River, and Powder River drainages, which are all tributaries of the Missouri River (**Map 1-1**). The major river valleys have wide flat floors and broad floodplains. Tributaries in the project area are incised and drain areas of isolated, flat-topped, clinker covered buttes and mesas, 100 to 500 feet above the valley floors. The drainage density is higher in the northern, southern, and western portions of the project area than in the central portion of the project area. The tributaries are ephemeral with flow occurring in response to storm events and snowmelt.

The Little Powder River flows north, draining the northeastern part of the project area north of Gillette. Its tributaries, from upstream to downstream include Rawhide, Corral, Cow, Cottonwood, Spring, Wildcat, Horse, White Tail, Elk, Dry, and Olmstead Creeks. The Belle Fourche River flows generally to the northeast, through the southern half of the project area. Principal tributaries from upstream to downstream include All Night, Fourmile, Mud Spring, Wild Horse, Threemile, Hay, Rattlesnake, Coal, Dry, Caballo and Donkey Creeks. Upper tributaries of the Cheyenne River generally flow east or southeast. These include Antelope, Little Thunder, and Black Thunder Creeks. The western and northwestern portions of the project area include upper tributaries of the Powder River, which flow southeast to northwest in the project area from Pleasantdale north. Tributaries include Beaver Creek, Dead Horse Creek, Barber Creek, Fortification Creek, Bull Creek, Deer Creek, Wild Horse Creek, Ivy Creek, Spotted Horse Creek, L-X Bar Creek, S-A Creek, and Bitter Creek.

The project area is semi-arid with average annual precipitation ranging from 11 to 16 inches. Approximately ten percent of the precipitation falls between December and February and 30 to 40 percent occurs between June and August (Martner 1986). The USGS has collected long-term flow information from some of the larger drainages. This information is summarized in **Table 3-2**. Surface water flow typically is expressed in cubic feet per second (cfs). One cfs is equivalent to 448.83 gallons per minute (gpm). Large flows or volumes of water often are expressed as acre-feet (ac-ft). One ac-ft is equivalent to 43,560 cubic feet or 325,851 gallons. Contributing watersheds varied in size from 72 to 1,690 square miles in extent. Flows ranged from no flow to 10,300 cfs (approximately 4,623,000 gpm) along the Belle Fourche River, just east of the project area below Moorcroft. At many sites the minimum flow also was the daily median flow, reflecting the semi-arid character of the area. There is very little base flow contribution from groundwater for streams originating in areas underlain by the Fox Hills-Wasatch sequence (USGS 1986c). Maximum flows occurred in May 1978, when the region experienced a flood of 0.5 percent probability, or a flood that occurs once every 200 years. The mean flows for larger drainages ranged between 0.66 cfs (approximately 300 gpm) for Raven Creek draining a 76-square mile watershed near Moorcroft and 24.02 cfs (approximately 10,800 gpm) for the Belle Fourche River below Moorcroft.

Table 3-2
Flow Statistics from USGS Gaging Stations in Wyodak Project Area

Station Name	Station Number	Drainage Area (sq. mi.)	Period of Record	Count (n)	Mean Flow (cfs)	Median Flow (cfs)	Minimum Flow (cfs)	Maximum Flow (cfs) Date
Little Powder River Basin								
Little Powder River Below Corral Creek Near Weston	06324890	204	08/31/77 - 09/30/83	2220	5.83	0.23	0	1620 05/18/78
Little Powder River Near Weston	06324925	540	09/01/77 - 10/07/81	1491	22.29	0.58	0	3130 05/18/78
Little Powder River Above Dry Creek Near Weston	06324970	1235	10/01/72 - 01/27/95	8154	19.34	2.30	0	5000 05/19/78
Belle Fourche Basin								
Belle Fourche Below Rattlesnake Creek Near Piney	06425720	495	10/01/75 - 09/30/83	2769	2.43	0.01	0	1060 05/19/78
Coal Creek Near Piney	06425750	71.8	10/01/80 - 09/30/83	1095	1.09	0	0	251 05/27/81
Belle Fourche Above Dry Creek Near Piney	06425780	594	10/01/75 - 09/30/83	2922	4.36	0.07	0	2150 05/18/78
Caballo Creek at Mouth Near Piney	06425900	260	08/31/77 - 09/30/83	2222	2.57	0	0	1500 05/19/78
Raven Creek Near Moorcroft	06425950	76	08/30/77 - 09/30/83	2223	0.66	0	0	213 03/20/78
Donkey Creek Near Moorcroft	06426400	246	08/31/77 - 10/08/81	1500	10.15	0.38	0	2530 05/19/78
Belle Fourche River Below Moorcroft	06426500	1690	10/01/43 - 09/30/96	15711	24.02	11	0	10300 05/19/78
Cheyenne River Basin								
Dry Fork Cheyenne River Near Bill	06365300	128	11/01/76 - 09/30/87	2525	0.83	0.08	0	631 05/18/78
Little Thunder Creek Near Hampshire	06375600	234	09/07/77 - 09/30/96	4773	1.88	0	0	1570 05/18/78
Powder River Basin								
Dead Horse Creek	06313700	151	10/01/71 - 09/30/90	6945	2.07	0.01	0	819 05/18/78

Source: USGS 1998

Table 3-3 summarizes average annual runoff for USGS gaging stations for which data are available for ten years or more. The Little Powder River, Black Thunder and Little Thunder Creek drainages generate between 10 and 19.9 ac-ft of runoff per square mile. Donkey Creek and the drainages tributary to the Powder River yield between 20 and 49.9 ac-ft per square mile. The Belle Fourche drainages exhibit annual runoff volumes between 0 and 9.99 ac-ft per square mile (USGS 1986c). These ranges of annual yields overestimate runoff within small watersheds, but broadly reflect the larger river basin. Average annual runoff

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ranges from 667 ac-ft per year on the Dry Fork at the Cheyenne River near Bill, Wyoming to 17,400 ac-ft per year at the Belle Fourche River below Moorcroft, Wyoming.

Table 3-3
Average Annual Runoff from Selected USGS Sites

Station Name	USGS Station Number	Average Annual Runoff (ac-ft)	Period of Record
Little Powder River Basin			
Little Powder River above Dry Creek near Weston	06324970	15,920	1973 - 1996
Belle Fourche Basin			
Belle Fourche River below Moorcroft	06426500	17,400	1944 - 1996
Cheyenne River Basin			
Dry Fork Cheyenne River near Bill	06365300	667	1978 - 1981 1986 - 1987
Little Thunder Creek near Hampshire	06375600	1,370	1977 - 1996
Powder River Basin			
Dead Horse Creek	06313700	1,510	1971 - 1990

Source: USGS 1996a and 1996b

Storm flows have been calculated by the BLM from data acquired at USGS stations and from other sites for which daily data were available. This information is tabulated on Table 3-4. Many stream reaches have very nominal flows during 2- and 5-year, 24-hour storm events.

The water produced from wells typically is expressed in gallons per minute (gpm). One gallon is equivalent to 0.134 cubic feet. One gpm is equivalent to 0.002 cfs (approximately). The flows generated by the discharge of produced water into surface waters typically are expressed in cubic feet per second (cfs). One cfs is equivalent to 448.83 gallons per minute (gpm).

Produced water from CBM development initiated in 1993 has supplemented stream flow in portions of the project area described in the Marquiss, Lighthouse, and Gillette North CBM Project EAs and the Gillette South CBM Project EIS (USDI BLM 1992c, 1995c, 1996a, and 1997a). Point source discharges ranging from 0.04 to 0.22 cfs (approximately 17 to 100 gpm) per location are supplementing existing flows or wetting otherwise dry channels year-round for some stream channel length or segment below the discharge points.

As of November 30, 2000, approximately 4,093 existing CBM wells in the Wyodak project area are currently producing water at a rate on average of 11.1 gpm or 55,416 acre feet per year (Greystone 2000). Flows within the Wyodak project area and outflows of surface waters from the project area are reduced by losses due to evapotranspiration to the atmosphere and leakage (infiltration) into underlying alluvium and geologic substrates. The analysis in Wyodak EIS assumed a loss of one percent per mile (WSEO 1998a). However, recent observations by BLM and others indicate this previously assumed rate of one percent per mile used in the Wyodak EIS is much less than the actual observed rate of loss. A recent unpublished

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Table 3-4
Predicted Storm Flows from USGS Gaging Stations[1]

Station Name	Station Number	Drainage Area (sq. mi.)	Flow					
			2-Year 24-Hour	5-Year 24-Hour	10-Year 24-Hour	25-Year 24-Hour	50-Year 24-Hour	100-Year 24-Hour
Powder River Basin								
Dead Horse Creek tributary near Midwest	06312910	1.53	223	386	524	733	917	1,130
Rucker Draw near Spotted Horse	06317050	3.98	84	335	696	1,530	2,570	4,100
Little Powder River Basin								
Little Powder River tributary near Gillette, WY	06324800	3.45	9	24	41	74	112	163
Little Powder River near Broadus, MT	06325500	2040	1,120	1,750	2,170	2,690	3,070	3,450
Belle Fourche River Basin								
Donkey Creek tributary above reservoir near Gillette, WY	06426195	0.2	27	65	99	152	198	249
Belle Fourche River below Rattlesnake Creek, near Piney	06426500	1690	797	1,740	2,770	4,720	6,830	9,660
Cheyenne River Basin								
Pritchard Draw near Lance Creek	06382200	5.1	610	1,160	1,660	2,450	3,180	4,030

[1] USGS 1988

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BLM study of the Belle Fourche drainage concludes, that during periods of little or no precipitation, evapotranspiration and infiltration losses may be greater than 90 percent (Meyer 2000). The study also states that similar trends have been observed in the Little Powder River drainage. These recent observations indicate little or no surface flows generated by CBM produced water discharge are reaching stream gaging stations in the Wyodak project area nor are the discharges flowing out of the project area. A specific infiltration study has been initiated as part of the ongoing Powder River Basin Oil and Gas EIS to further quantify the stream/drainage losses within the larger Powder River Basin EIS analysis area.

Stream channels in the Wyodak project area are relatively narrow, with silt and clay bottoms that are grass covered in places (USDI BLM 1997a). Natural stream flow results primarily from thunderstorms and snowmelt. The groundwater table is intercepted in many reaches; however, very little groundwater is contributed to stream flow. Established floodplains exist along the Little Powder River, Belle Fourche River, Powder River, and Cheyenne River and their larger tributaries.

Surface water data (daily discharge, annual peak flow discharge, water quality, sediment, biology) are available from a few USGS stations near the project area. Mines located downstream have collected additional data. The following discussion of water quality was acquired from the Hydrology of Area 50, Northern Great Plains and Rocky Mountain Coal Provinces, Wyoming and Montana (USGS 1986c).

The water is hard due to the concentrations of calcium and magnesium. Surface waters are alkaline within Area 50 and have pHs ranging from 6.1 to 9; most pHs are greater than 8. Alkalinity is high and exceeds 200 mg/L $CaCO_3$. Pyrite, the precursor of acid mine drainage is present, but high levels of alkalinity buffer the system to prevent acid mine drainage.

Sediment loads are elevated. Sediment concentrations increase in a direct relationship to flow, increasing downstream and during peak flow periods. Clay particles comprise between 38 and 97 percent of the sediment load.

More than 50 percent of the surface water stations had average and median dissolved solids concentrations greater than 2,000 mg/L. There is seasonal variability in an inverse relationship to flows that results in a ten-to-twenty fold difference in Total Dissolved Solids (TDS) concentrations between peak flow periods and low flow periods. TDS concentrations from the Little Powder River area vary between 1,200 mg/L for a peak flow and 3,600 mg/L for low flow. Data from stations on the Belle Fourche document TDS concentrations vary between 750 and 4,700 mg/L. Stations on the Cheyenne River record TDS concentrations between 500 and 3,550 mg/L.

Supplemental flows of CBM produced water are typically slightly alkaline, hard sodium bicarbonate waters (Table 3-8) (USGS 1984). TDS levels averaged 764 mg/L for CBM water discharges reported to WDEQ in 1998 (WDEQ 1998). A recent USGS publication on constituents of CBM produced waters collected from 47 wells in the Wyodak project area reports that TDS ranges from 370 to 1,940 mg/L with a mean of 840 mg/L (Rice et al. 2000). The 764 mg/L and 840 mg/L TDS levels are generally an improvement in water quality for most streams in the project area under all flow levels. The national drinking water standard recommendation for potable water is 500 mg/L TDS (Table 3-6).

Table 3-5
Statistical Summary of WDEQ Discharge Monitoring Report Data
(12/31/93 - 12/31/97)

	Flow		EC	TDS[1]	pH	Radium 226	TPH
	mgd	gpm	µmhos/cm	mg/L	S.U.	pCi/l	mg/L
Mean	0.05	34.6	1146	764	7.2	<0.44	<0.529
Standard Error	0.0028		22.70	22.70	0.014	0.0489	0.015
Median	0.03	23.3	992	662	7.2	<0.20	0.500
Minimum	0.00	0.0	110	73	5.7	<0.20	0.000
Maximum	1.14	791.5	6380	4255	8.7	10.60	8.400
Count	569	569	577	577	580	330	576.000
Confidence level (0.95)	0.0055	0.0055	44.49	44.49	0.028	0.0959	0.029

[1] TDS values derived from multiplying conductivity values by 0.667.

Source: WDEQ 1998.

Table 3-6
Water Quality Criteria[1]

Use Suitability	Constituent[2]			
	Sodium	Chloride	Sulfate (mg/L)	Total Dissolved Solids
Livestock				
Good	—	—	<500	<1,000
Fair	—	—	500 - 1,000	1,000 - 3,000
Poor	2,000	—	>1,000	>3,000
Irrigation				
Good	<30%[3]	<200	<200	<500
Fair	30 - 75%	200 - 550	500	500 - 2,000
Poor	>75%	>550	200 - 1,000	>2,000
Domestic	<115	<250	<250	<500

[1] Source: McKee and Wolf 1963, USEPA 1976, USGS 1985.

[2] All values are in mg/L unless as noted.

[3] Exchangeable sodium percentage (ESP) is calculated from meq/l by the following equation as:

$$\frac{\text{Na} \times 100}{\text{K} + \text{Na} + \text{Mg} + \text{Ca}^{\text{meq/l}}}$$

Rice et al. (2000) indicate that TDS in waters of the Wyodak-Anderson coal increases from south to north and from east to west. These trends of increasing TDS are generally a result of an increase in sodium and bicarbonate content of the water. Sodium and bicarbonate are the dominant cation and anion, respectively, in PRB CBM water. Sulfate levels among the 47 samples range from a high of 17 mg/L to less than 0.01 mg/L (mean of 2.4 mg/L). These low values for sulfate have a direct inverse influence on barium concentrations in CBM water. The low sulfate levels have resulted in barium levels in the sampled CBM waters that are relatively high compared to most other groundwater sources (Rice et al. 2000). Among

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the 47 samples, barium levels range from a high of 1.6 mg/L to a low of 0.14 mg/L (mean of 0.62 mg/L). Barium levels for three of the 47 samples exceed the drinking water standard of 1.0 mg/L (Table 3-7).

Table 3-7
Summary of Constituents of CBM Produced Water from Wells in Wyodak Project Area (6/24/99-5/8/00)

	EC µS/cm	TDS mg/L	As mg/L	Ba mg/L	Fe mg/L	Mn mg/L	Se mg/L	Cl mg/L	SO_4 mg/L	SAR
Mean	1300	850	0.0004	0.62	0.8	0.032	<0.002	13	2.4	12
Minimum	470	270	<0.0002	0.14	0.02	0.018	<0.002	5.2	<0.01	5.7
Maximum	3020	2010	0.0026	1.6	4.9	0.101	<0.002	64	17	32
Count	47	47	47	47	47	47	47	47	47	47

Source: Rice et al. 2000

As a result of a recent antidegradation review and findings analysis for barium, WDEQ has proposed a permitting strategy for discharge of CBM produced waters that will ensure the water quality in an affected watershed will:

- Not exceed the 2,000 µg/l human health criterion for barium on Class 2 waters (state designated high quality waters that are protected for fisheries and public drinking uses);
- Fully support all designated uses in relation to barium concentrations; and
- Maintain barium degradation and risk to human health at insignificant levels (WDEQ 2000).

If approved by the Administrator of the Water Quality Division (WQD) following a review of public comments, this permitting strategy would set an effluent limit of 1800 µg/l for discharges in all watersheds.

Manganese concentrations exceed the domestic secondary standard of 0.05 mg/L in approximately 17 percent of the 47 samples. Iron concentrations exceed the domestic secondary standard of 0.3 mg/L in 68 percent of the samples. Manganese and iron can cause staining and bitter tastes. Neither metal is present in concentrations that would limit use for stock watering or irrigation. Arsenic and selenium concentrations do not exceed drinking water standards for any of the 47 samples (Table 3-6).

The sodium adsorption ratios (SARs), representing the proportions of sodium to calcium and magnesium in solution, for the 47 CBM water samples range from a low of 5.7 to a high of 32 (mean of 12). Irrigation water having SAR values of 10 to 15 and greater poses a potential hazard to the health of individual plants growing in the irrigated soils, and thus, to productivity/yield of the irrigated cropland. The application of high SAR irrigation waters results in a disproportionate concentration of sodium adsorbed by the soil at the

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expense of calcium and magnesium that alters the physical condition of the soil growth medium. The sodium imbalance causes soil structure to breakdown and the soil particles, especially the clay-sized, to disperse. This dispersion of soil particles causes the soil to become compact and hard and increasingly impervious to infiltrating water and air, both of which are necessary for sustaining plants. Of the 47 samples, 16 (34 percent) have SAR values equal to or greater than 10. The irrigation hazard to sustained crop production posed by higher SAR levels alone is further exacerbated by higher overall salinity levels of the irrigation water as measured by electrical conductivity. Of the 47 CBM water samples, 39 (83 percent) have a combined SAR (sodium) and salinity hazard that equates to an unsuitable classification for use as irrigation water for plants that are not tolerant of saline and sodic soil conditions.

Although CBM produced water may not be suitable for irrigation of crops, the quality of the CBM water in the area is generally suitable for livestock consumption. Table 3-6 shows water quality criteria related to livestock, agricultural, and domestic use. Table 3-8 presents water quality data from the Belle Fourche River just downstream of the project area.

The study area includes several streams which are designated for aquatic life:

Little Powder River	Warm water fishery Class-2
Belle Fourche River	Warm water fishery Class-2
Rawhide Creek	Marginal fishery Class-3
Antelope Creek	Warm water fishery Class-2
Little Thunder Creek	Warm water fishery Class-2

The remaining tributaries are Class-4 waters, protected for only livestock and irrigation.

The State of Wyoming's Annual 305(b) Report to EPA (WDEQ 2000) identifies limitations in use attainment from siltation and sediment, nutrients, TDS, flow, and habitat alterations. The rivers of Campbell and Converse counties mirror that assessment with the primary contaminant in most surface waters being sediment. Sediment concentrations are naturally high in the plains streams within the basin and can be aggravated by human activities. Any surface-disturbing activity or activity that reduces watershed cover (vegetation) can increase erosion, influencing sediment concentrations and loads. The 305(b) report attributes the sources of pollution to overgrazing in rangeland and pasture land; cropland; and the construction of highways, roads, and bridges.

In addition, the 305(b) report identifies an impairment to warm water fisheries of the Powder River for an unknown distance below Salt Creek from elevated levels of selenium and chloride.

The State of Wyoming 2000 Section 303(d) (WDEQ 2000) identifies waterbodies within the state that do not support all of their designed uses. Gillette Fishing Lake, located south of Gillette on Donkey Creek, a tributary of the Belle Fourche River, has elevated levels of silt and phosphate that impair or are a threat to the warm water fishery. This was the only site identified within the project area.

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Table 3-8
Chemical Analyses of Waters from the Belle Fourche River below Rattlesnake Creek near Pinny, Wyoming

Parameter	Units	Number of Samples	Mean	Drinking Water Standard	Maximum	Minimum
SITE DESCRIPTION: Belle Fourche River below Rattlesnake Creek. Site located just below the [illegible] Road. USGS Site ID [illegible] LOCATION: North latitude 43-[illegible], west longitude 105-[illegible]. DRAINAGE AREA: [illegible] square miles. PERIOD OF OPERATION: November 6, 1975 through April 12, 1983, and 1994 to 1996.						
Water temperature	°C	96	12.31		23.0	0.0
Discharge	cfs	102	13.14		1,060.0	0.0
Specific conductivity	µmhos/cm	42	3,962.00		6,900.0	1,100.0
pH	standard units	36	7.93	None	8.1	7.6
Total organic carbon	mg/L	3	9.60		16.0	6.6
Calcium *	mg/L	36	276.00		550.0	95.0
Magnesium *	mg/L	36	171.00		330.0	25.0
Sodium *	mg/L	36	480.00	None	1,200.0	100.0
Potassium *	mg/L	36	16.00		45.0	6.6
Chloride *	mg/L	36	20.00	250 (recommended)	55.0	4.1
Sulfate *	mg/L	36	1,807.00	250 (recommended)	3,400.0	510.0
Fluoride *	mg/L	36	0.45	1.4 - 2.4	0.9	0.2
Silica *	mg/L	36	3.00		9.6	0.2
Silver *	µg/l	10	1.10	5	1.0	2.0
Barium *	µg/l	6	67.50	1,000	100.0	50.0
Beryllium *	µg/l	6	7.00	None	10.0	0.0
Boron *	µg/l	36	131.00	None	610.0	50.0
Cadmium *	µg/l	10	2.40	10	10.0	0.0
Chromium *	µg/l	10	5.00	50	20.0	0.0
Copper *	µg/l	10	3.10	None	7.0	1.0
Iron *	µg/l	36	77.00	None	610.0	10.0
Lead *	µg/l	10	3.90	50	21.0	0.0
Manganese *	µg/l	16	224.00	None	800.0	10.0
Molybdenum *	µg/l	3	3.20		6.0	0.0
Nickel *	µg/l	10	3.40	None	6.0	1.0
[illegible] *	µg/l	1	0.00	50	0.0	0.0
Strontium *	µg/l	3	2,267.00		3,400.0	1,000.0
Vanadium *	µg/l	6	0.325		1.0	0.0
Zinc *	µg/l	10	20.40	50	40.0	4.0
Aluminum *	µg/l	3	36.70		120.0	19.0
Lithium *	µg/l	8	116.00		390.0	36.0
Selenium *	µg/l	10	1.00	10	2.0	0.0
Uranium *	µg/l	3	9.23		17.0	1.7
Total dissolved solids	mg/L	33	3,046.00	500 (recommended)	7,070.0	400.0
Mercury *	µg/l	10	0.13	2	0.5	0.0

* Total dissolved

Source: [illegible]

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Erosion occurs locally in three forms: sheet erosion, gully erosion, and channel/stream bank erosion. Sheet erosion usually can be managed by minimizing surface disturbance and maintaining a good vegetative cover. Gully erosion occurs in steeper terrain underlain by sedimentary rocks common in the plains portions of the area. The Wasatch and Fort Union Fms are particularly susceptible to gully erosion. This type of erosion is difficult to control once initiat[illegible]wth of the gully is a function of water discharge magnitude and duration, which is in turn a function of watershed slope and surface roughness or cover. Gullies can be controlled by controlling discharge and, conversely, sustained or reactivated through increases in discharge over the equilibrium state. Gully erosion follows a threshold pattern. Once gully erosion has occurred, even control of the discharge back to the previous equilibrium level will not stop the growth of the gully. Stream bank and channel erosion are controlled by stream dynamics. Changes in peak flows, sediment load, or base flow all can cause changes in channel morphology. Within most drainages, sediment concentration increases in a downstream direction; however, sediment yield per unit area decreases. The decrease in yield per unit area is caused by decreasing gradients and wider, better-developed floodplains.

Surface water withdrawals within the project area totaled 36.94 million gallons per day (mgd). Table 3-9 summarizes water use in 1990 (USGS 1998a). The 1990 water year in the Powder River Basin saw runoff that was 50 to 70 percent of normal. Almost half of the water was used within the Belle Fourche River basin. Slightly less than half was used in that reach of the Powder River basin between Midwest and Arvada, Wyoming (USGS Hydrologic Unit 10090202). The data from this reach includes contributions from tributaries west of the Powder River, and does not include project area contributions to the Powder River in the far northwest portion of the area. Surface water consumption in the project area is predominantly associated with irrigation use (28.88 mgd). Mining use totals 6.22 mgd. The public water supply for the 33,400 people living in the drainage basins in 1990 is acquired mainly from groundwater supplies.

Groundwater

Groundwater resources in Campbell County are derived from non-regional, Quaternary alluvial aquifers adjacent to rivers and aquifers within the lower Tertiary Wasatch/Fort Union Fms. Deeper, underlying regional aquifers include the following: the Upper Cretaceous Lance/Fox Hills; the Lower Cretaceous Dakota; and the Paleozoic Madison. These units represent the majority of the significant water-bearing strata; however, there are a few wells completed in formations which are included in "aquitard" groups. These are typically lower yield and poorer quality except near the outcrop. In addition to water supplies that can be developed from these aquifers, there are a few springs typically of the contact type, often at the base of exposed clinker. A generalized description of the Wasatch/Fort Union geology of this area is in Table 3-1.

The Wasatch/Fort Union aquifer group includes the Wasatch Fm and the Tongue River (which includes the Wyodak coal), Lebo, and Tullock members of the Fort Union Fm. The Wasatch sand aquifer forms the top of the Fort Union sequence. It is underlain by the Wyodak coal, the source of the coal bed methane for this project. The thickness of the shallowest of the bedrock aquifer systems in the PRB ranges to more than 3,000 feet (Feathers et al. 1981).

Table 3-8 1990 Water Uses¹ Within the WYODAK Project Area							
Category	Little Powder River	Belle Fourche River	Antelope Creek	Upper Cheyenne River	Dry Fork Cheyenne River	Upper Powder River²	Project Area Totals
Totals							
Withdrawals, groundwater	4.87	12.42	3.35	4.44	0.59	3.17	**28.84**
Surface water withdrawals	4.45	16.68	1.11	1.44	0.24	13.02	**36.94**
Total Withdrawals	9.32	29.10	4.46	5.88	0.83	16.19	**65.78**
Public Supply							
Groundwater withdrawals, fresh	0.12	4.20	0.00	0.00	0.00	0.00	4.32
Commercial							
Groundwater withdrawals, fresh	0.00	0.05	0.00	0.00	0.00	0.00	**0.05**
Surface water withdrawals, fresh	0.00	0.04	0.00	0.00	0.00	0.00	**0.04**
Domestic							
Self-supplied groundwater withdrawals, fresh	0.20	0.58	0.01	0.02	0.01	0.09	**0.91**
Self-supplied surface water withdrawals, fresh	0.01	0.03	0.00	0.00	0.00	0.00	**0.04**
Industrial							
Total self-supplied withdrawals, groundwater	0.00	0.26	0.00	0.00	0.00	0.00	**0.26**
Self-supplied surface water withdrawals, fresh	0.00	0.17	0.00	0.00	0.00	0.00	**0.17**
Mining use							
Total withdrawals, groundwater	4.22	6.83	3.30	4.37	0.56	2.99	**22.27**
Total withdrawals, surface water	1.18	1.91	0.91	1.22	0.14	0.84	**6.22**
Consumptive use, total	2.16	3.78	1.55	2.72	0.22	0.65	**11.08**
Livestock (stock) use							
Total withdrawals, groundwater	0.29	0.12	0.04	0.03	0.02	0.09	**0.60**
Total withdrawals, surface water	0.24	0.58	0.18	0.22	0.10	0.33	**1.59**

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Table 3-9 (continued)
1990 Water Uses[1] Within the WYODAK Project Area

Category	Little Powder River	Belle Fourche River	Antelope Creek	Upper Cheyenne River	Dry Fork Cheyenne River	Upper Powder River[2]	Project Area Totals
Irrigation use							
Groundwater withdrawals, fresh	0.04	0.38	0.00	0.00	0.00	0.00	0.42
Surface water withdrawals, fresh	3.02	14.03	0.00	0.00	0.00	11.83	28.88
Conveyance loss	0.30	4.24	0.00	0.00	0.00	4.73	9.27
Consumptive use, total	1.57	2.38	0.00	0.00	0.00	2.50	6.45
Reservoir evaporation[3]							
Reservoir evaporation	0.00	10.44	0.00	0.00	0.00	0.00	10.44

[1] Water use is expressed in millions of gallons per day (mgd).

[2] The Upper Powder River Basin is USGS cataloguing unit 10090202 and is located between Midwest and Arvada, WY. This data does include contributions from tributaries west of the Powder River, outside the project area. This reach of the Powder River does not include project area contributions to the Powder River in the far northwest portion of the area. The values in this column overstate water use of the Powder River within the project area.

[3] Reservoir evaporation during 1990 is expressed in thousands of acre-feet.

Source: USGS 1996a

For Reference:
One gallon = 0.134 cubic feet
One acre-foot = 43,560 cubic feet
There are 325,851 gallons per acre-foot

Alluvial Aquifers

Alluvial aquifers consist of unconsolidated sand, silt, and gravel that underlie floodplains and the adjacent stream terraces. Thicknesses are usually less than 50 feet. Alluvium overlying Tertiary sediments (Fort Union and above) in the central part of the PRB is mostly fine-to medium-grained sand and silt. Coarser deposits occur in the valleys of the Belle Fourche, Cheyenne, Powder, and Little Powder rivers (USGS 1973). Water yield from the alluvium is a function of grain size and grain-size distribution. Recharge results from surface infiltration and discharge from underlying strata. Local groundwater movement dominates in these systems, movement is along the drainage in a downstream direction.

Water quality in alluvium within the PRB is quite variable. Concentrations of TDS vary from 100 to more than 4,000 mg/L; however, they most commonly range from 500 to 1,500 mg/L (USGS 1973). Analyses from eight wells completed in alluvium within the project area have TDS concentrations that average 2,232 mg/L, and vary between 467 and 6,610 mg/L. Most waters have calcium or sodium as the dominant metal ion and sulfate as the dominant base ion. An area of sodium bicarbonate alluvial groundwater exists in the northeast portion of the project area (USGS 1973).

Clinker Aquifers

Clinker aquifers consist of highly fractured rocks formed by the natural burning of coal beds. The following discussion is taken from Heffern and Coates (2000). High permeability and infiltration rates enable the 1600 square miles of clinker in the PRB to store large amounts of water from rainfall and snowmelt, and protect it from evaporation. This water is slowly discharged to springs, streams and aquifers downdip, helping to maintain perennial streams during dry periods. These unconfined clinker aquifers have very high transmissivity and storativity values. Springs which emerge from the base of clinker form the headwaters of several perennial streams (including the Little Powder River) and provide wetland habitat for many species. In the Rochelle Hills of Wyoming, groundwater from clinker recharges coal, overburden, and spoil aquifers downdip to the west. Some coal mines encounter inflow from large saturated clinker bodies updip, where water is dammed against the face of the less permeable coal.

Groundwater quality in clinker varies widely. Quality appears better in well-drained areas where soluble materials in the clinker have dissolved away, and on clinker-capped plateaus where burning has removed most or all of the coal. These areas are generally updip and farther away from the burn line, and contain younger water. Quality is poorer where water in clinker has ponded along a contact (burn line) with unburned coal downdip. Total dissolved solids (TDS) values range from 200 to 10,000 mg/l. Major cations include calcium, magnesium, and sodium. Dominant anions vary from sulfate in clinker next to a burn line to bicarbonate in clinker downdip from coal or in clinker plateaus where little or no coal remains. Clinker springs on these plateaus commonly have calcium-bicarbonate type water with TDS values under 400 mg/l.

In the 30-by-80 square mile area containing the major coal mines in the eastern PRB of Wyoming and the towns of Gillette and Wright, Heffern and Coates (2000, Plate 1) mapped 153 square miles (98,000 acres) of clinker.

Wasatch Aquifer

The Wasatch aquifer consists primarily of fine- to medium-grained lenticular sandstone beds and sand channels surrounded and interbedded with siltstone, shales, and coals. The thickness increases from east to west from 300 feet at the eastern boundary of the project area to over 1,000 feet at the western limit of the project area. Wasatch shales and siltstones generally do not yield enough water even for intermittent livestock use.

Wells completed in sandstone lenses or sand channels yield 10 to 50 gpm (approximately 0.02 to 0.1 cfs) in the northern portion of the project area. Wells completed near the southern portion of the PRB can yield as much as 500 gpm, which is approximately equivalent to 1 cfs, (USGS 1988). Artesian conditions are common away from the outcrop, particularly from deeper isolated sands. Recharge to the Wasatch Fm is through surface infiltration of precipitation and lateral movement of water from adjacent clinker, spoil, and alluvium.

Natural discharge occurs at small seeps and springs along surface drainages. Local flow systems are predominant with discharge occurring along creeks and tributaries near recharge areas. Regional groundwater movement is toward the north, but is extremely slow due to the fine-grained and discontinuous nature of most of the Wasatch sands.

The prediction of groundwater movement and chemical quality in the PRB can be complex and locally variable. Local leakage between aquifers can occur as a result of faulty well completion techniques and corrosion of casing in old wells where poor quality water initially was cased off (USGS 1974). Furthermore, the PRB has been drilled extensively in the course of mineral exploration; inconsistent plugging of test holes also is a potential concern. Commingling of aquifers could occur to some degree within the project area.

Water types within the Wasatch Fm are predominantly sodium sulfate and sodium bicarbonate. However, some calcium or magnesium sulfate waters are found in the eastern portion of the project area (USGS 1973). Dissolved solids concentrations in 257 samples acquired from the Wasatch vary between 227 and 8,200 mg/L, have a median concentration of 1,010 mg/L, and have an average concentration of 1,298 mg/L (USGS 1986c). Analyses from approximately 143 wells completed in the Wasatch, located in and near the project area, vary between 146 to 8,200 mg/L dissolved solids and have an average concentration of 1,415 mg/L (USGS 1984).

Analysis of trace metals was conducted for approximately 33 wells completed in the Wasatch (USGS 1984). Selenium concentrations in groundwater range from below the analytical method detection limits in 32 of the samples to 0.02 mg/L (USGS 1984). The Quality Standards for Wyoming groundwaters identify acceptable concentrations of selenium for domestic, agriculture and livestock use as 0.01 mg/L, 0.02 mg/L and 0.05 mg/L, respectively. The detection limit in a number of the samples (1 mg/L) was greater than the standards. Selenium exceeded the drinking water standard in 4 of 159 samples compiled from the Powder River coal field. Dissolved selenium concentrations, ranging from 0.003 to 0.330 mg/L, reported in Selenium: Reclamation and Environmental Impacts, Special Symposium June 1995, have been recognized in shallow post mining groundwater (spoils) from coal mines in the PRB (USGS 1988, Naftz and Rice 1989). The selenium concentrations in these areas probably result from exposure of crushed Wasatch overburden materials to oxidizing conditions. Oxidizing conditions decrease the stability of selenium-containing oxides and organic matter, resulting in increased selenium concentrations within backfill materials and waters discharging from them (ASSMR 1995).

Fort Union Formation

The upper part of the Tongue River Member of the Fort Union Fm contains as many as 11 coal beds (Flores et al. 1999) and many discontinuous, lenticular sandstone layers. The Wyodak coal zone has been correlated in many parts of the PRB and has been given different names in different parts of the basin as described in the previous Geology and Mineral Resources section of this EA. This zone splits and merges into thick pods in an irregular pattern (Flores 2000). Coal beds equivalent to the Wyodak are tentatively correlated in the vicinity of Sheridan on the western side of the PRB. Recent work by the USGS indicates that the Wyodak combines with other coals to form a 200-ft thick coal seam known as the Big George at a depth of over 1,000 feet in western Campbell County (Flores 2000). For ease of reference in this EA, the main coal seam that is the target of CBM development will be referred to as the Wyodak, and where it splits into two distinct seams, they will be referred to as the Upper and Lower Wyodak.

The Wyodak coal occurs at the top of the Fort Union sequence and is the most continuous hydrogeologic unit in the project area. The determination that the coal is a confined aquifer away from the outcrop is further documented by the USGS (1986c) and in various mine permit application packages (PAPs) on file with the WDEQ/LQD. Artesian conditions exist away from the outcrop. The aquifer consists of the Wyodak and associated coals, where the Wyodak splits and separates into multiple seams, interbedded sandstones, and clinker beds. Flow of water in the aquifer is affected in places where the coal seam splits and is interbedded with claystone, shale, and sandstone. Flow in the aquifer also is affected by differences in aquifer properties, caused by varying pattern and degree of fracturing in the coal and by faulting. The permeability of the coal-bearing bed is a function of fracturing. The coal is not isotropic (uniform), and the flow occurs in fractures within the coal. Wells completed within coal generally yield from 10 to 50 gpm (approximately 0.02 to 0.1 cfs) (USGS 1975). Recharge occurs primarily along the clinker outcrop areas with a small amount of leakage from the overlying Wasatch Fm. Recharge into the coal could also come from spoil and alluvial aquifers.

Recharge and discharge also occur locally, where coal underlies valley fill deposits (USGS 1988). As more operating mines are reclaimed, reclaimed mine areas may become recharge areas for adjacent, undisturbed Wyodak coal. Regional flow is to the northwest and away from the recharge areas, as indicated by the potentiometric surface map prepared by Daddow (USGS 1986b). In the southern portion of the project area, water flow is to the north, moving toward local discharge areas where Antelope and Porcupine Creeks cross coal outcrops (USGS 1988). Local flow patterns may differ from regional flow.

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Available data suggests that near-surface Fort Union wells do not show a dominant water type but consist primarily of calcium or magnesium sulfate water. As depth increases below 100 feet, calcium and magnesium ions are replaced by sodium and bicarbonates. The predominant water types of existing water wells within the Fort Union Fm consist primarily of sodium bicarbonate and to a lesser extent sodium sulfate (USGS 1973). Wells penetrating coal seams or other carbonaceous deposits often yield both water and gas (primarily methane). Lee (1981) found that groundwater chemistry of the Fort Union Fm in the northern PRB was highly variable at depths of less than 200 feet, but was dominated by sodium and bicarbonate ions below 200 feet.

Solute concentrations within the Fort Union Fm are variable. Past sampling of water from the Fort Union Fm for TDS yielded an average concentration of approximately 1,350 mg/L for 73 samples from the Wyodak project area (USGS 1984). The best quality water typically has been obtained from isolated clinker plateaus (Heffern and Coates 2000). This average TDS concentration was consistent with previous analysis of water from coal beds that typically contained between 1,000 and 2,000 mg/L TDS (USGS 1974). More recently, the quality of water contained in coal seams has been described in various coal mine PAPs and annual monitoring reports on the file with WDEQ/LQD, and was summarized by the USGS (1988). Based on 379 samples from the Wyodak-Anderson coal aquifer, the median concentration of TDS was 1,310 mg/L. Baseline data from the Rocky Butte Mine lists average TDS concentrations of 1,210 and 2,120 mg/L, reported by Carter and Wyodak, respectively (USDI BLM 1992a).

As described previously in the water quality discussion for surface water and produced water, TDS levels averaged 764 mg/L for CBM water discharges reported to WDEQ in 1998 (WDEQ 1998). A recent USGS publication on constituents of CBM produced waters collected from 47 wells in the Wyodak project area reports that TDS ranges from 370 to 1,940 mg/L with a mean of 840 mg/L (Rice et al. 2000). Specific TDS levels and concentrations of other key water quality parameters for Fort Union Fm coal aquifers (CBM produced water) were discussed previously in the surface water section of this EA.

Tongue River/Lebo

The Tongue River/Lebo consists of sandstones grading to mudstone with depth (Heffern 2000). Wells in the Tongue River/Lebo unit typically yield adequate quantities of water for domestic and livestock use if a sufficient thickness of saturated sandstone is penetrated. Stratigraphically lower aquifers are partially isolated from impacts reaching from dewatering associated with mine activities and CBM production in the Wyodak coal aquifers. As with other Fort Union aquifers, recharge is primarily from inflow at outcrop areas. Groundwater generally flows north. Water quality for the Tongue River/Lebo is as described above for the Wyodak coal aquifer.

Tullock Aquifer

The Tullock aquifer consists of fine- to medium-grained sandstone layers and thin coal seams interbedded with siltstone, shale, and carbonaceous shale (USGS 1988). Sandstone channel deposits comprise about one third of the section; fine-grained overbank sediments make up the remaining two thirds. The Tullock was deposited in anastomosed river systems that flowed to the east and is 500 to 1,500 feet thick in the project area (Brown 1993). The Tullock is separated from the overlying members of the Fort Union Fm by a leaky confining layer (Lebo shale/mudstone). The Tullock is exposed in the west along the Bighorn Uplift and in the east, east of the Little Powder River, in a series of dissected ridges (USGS 1987). Water yields of 200 to 300 gpm (approximately 0.4 to 0.6 cfs) are available from the Tullock, making this zone attractive for municipal and industrial uses. Most wells for mine facilities are completed in this aquifer. Recharge to the Tullock results from leakage through overlying strata and infiltration along the outcrop areas.

Water Use

Groundwater consumption in the project area averages 28.84 million gallons per day or 32,300 acre-feet per year (**Table 3-9**) (USGS 1998b). More than 40 percent of this consumption is in the Belle Fourche River watershed. Mining related withdrawals associated with pit dewatering and operational consumption account for 77 percent of the groundwater use in the project area. All water for domestic consumption is derived from groundwater supplies, predominantly from the Tullock aquifer. Over 90 percent of domestic consumption occurs in the Belle Fourche River Basin, where most of the population resides. Stockwatering and irrigation uses of groundwater accounted for slightly more than one million gallons per day in 1990.

The Wasatch and Fort Union aquifers are the most important local sources of groundwater in the PRB (Feathers et al. 1981). They are developed extensively for shallow domestic and livestock wells. Domestic and livestock wells usually are low yield, (less than 25 gpm or 0.05 cfs), intermittent producers. Water suitable for domestic and livestock uses typically can be found less than 1,000 feet below the surface. Industrial water wells are used primarily to obtain water for use in subsurface injection that promotes secondary recovery of petroleum. At coal mines these wells are used for drinking water and dust abatement. Municipal water supply wells in the project area are predominantly associated with the City of Gillette's use of the Tullock aquifer. Gillette's main water supply wells are located outside of the project area, about 30 miles east of the City, in the Madison aquifer. Municipal water use in Gillette exceeded 1.3 billion gallons for the year 1999 (White 2000).

There are more than 10,000 WSEO-permitted water wells in and around the project area (T40-58 N R70-75W; T45-56N R76W; and T48-52N R77W) of which approximately 3,600 have been canceled or abandoned. Of the remaining approximately 6,900 wells, approximately 4,000 are monitor wells. The list is too lengthy to include in this document but is available at WSEO. The remaining approximately 2,900 wells are used for domestic, industrial, irrigation, municipal, reservoir and stock purposes. The water well location data for all permitted water wells in Wyoming is available from the Wyoming State Engineers Office (WSEO 1998b and 1999). Table 3-10 summarizes groundwater use in the Wyodak project area in 1990.

Table 3-10
1998-1999 Data on Type and Number of Wells in the Wyodak Project Area
(T40-58 N R70-75 W; T45-58N R76W; and T48-52N R77W)

Primary Use	Number of Wells
Monitor, Miscellaneous, Dewater	[illegible]
Domestic	510
Industrial	195
Irrigation	29
Municipal	28
Reservoir	22
Stock (not including CBM)	2,163
Unknown	16
TOTAL	6,925

4/10/1998 and 2/1/99 Listings
Source: WSEO 1998 and 1999

CLIMATE

The climate of the eastern PRB is semi-arid with average annual precipitation ranging from 11 to 16 inches. In the project area, 30 to 40 percent of the annual precipitation usually occurs in June, July, and August. Only ten percent of the annual precipitation occurs in December, January, and February (Martner 1986).

Average annual temperature for the project area is approximately 46°F, with July being the warmest month and January the coldest (USDI BLM 1997a). Lake and pan evaporation rates are 42 and 60 inches per year, respectively (USDC NOAA 1979).

The wind data provided by the Air Quality Division of WDEQ for the Hampshire Energy project, shown on Figure 3-1, is representative of the project area. Regionally, winds typically come from the northwest and southeast with a secondary maximum from the southwest. Average annual wind speeds range from 9.2 to 13.1 miles per hour, with the highest wind speeds occurring in the winter and spring when gusts frequently reach 30 to 40 miles per hour (USDI BLM 1979).

AIR QUALITY

In the vicinity of the project area, the main sources of air pollution are natural sources of dust, vehicle traffic, surface coal mines, power plants, and various sources associated with oil and gas production facilities and pipelines. Vehicle traffic is responsible for tailpipe emissions, which consist mainly of nitrogen oxides (NO_x) and carbon monoxide (CO), and for the emission of fugitive dust from paved and unpaved surfaces. The main pollutants of concern associated with surface coal mining are fugitive dust from vehicle traffic and earth moving activity and NO_x from mining vehicles, blasting, and coal transport trains. Fossil fuel-fired power plants, compressor stations, and large generators produce emissions of NO_x, sulfur dioxide (SO_2), CO, particulates (TSP, and PM_{10}), volatile organic compounds (VOCs), and smaller amounts of other pollutants.

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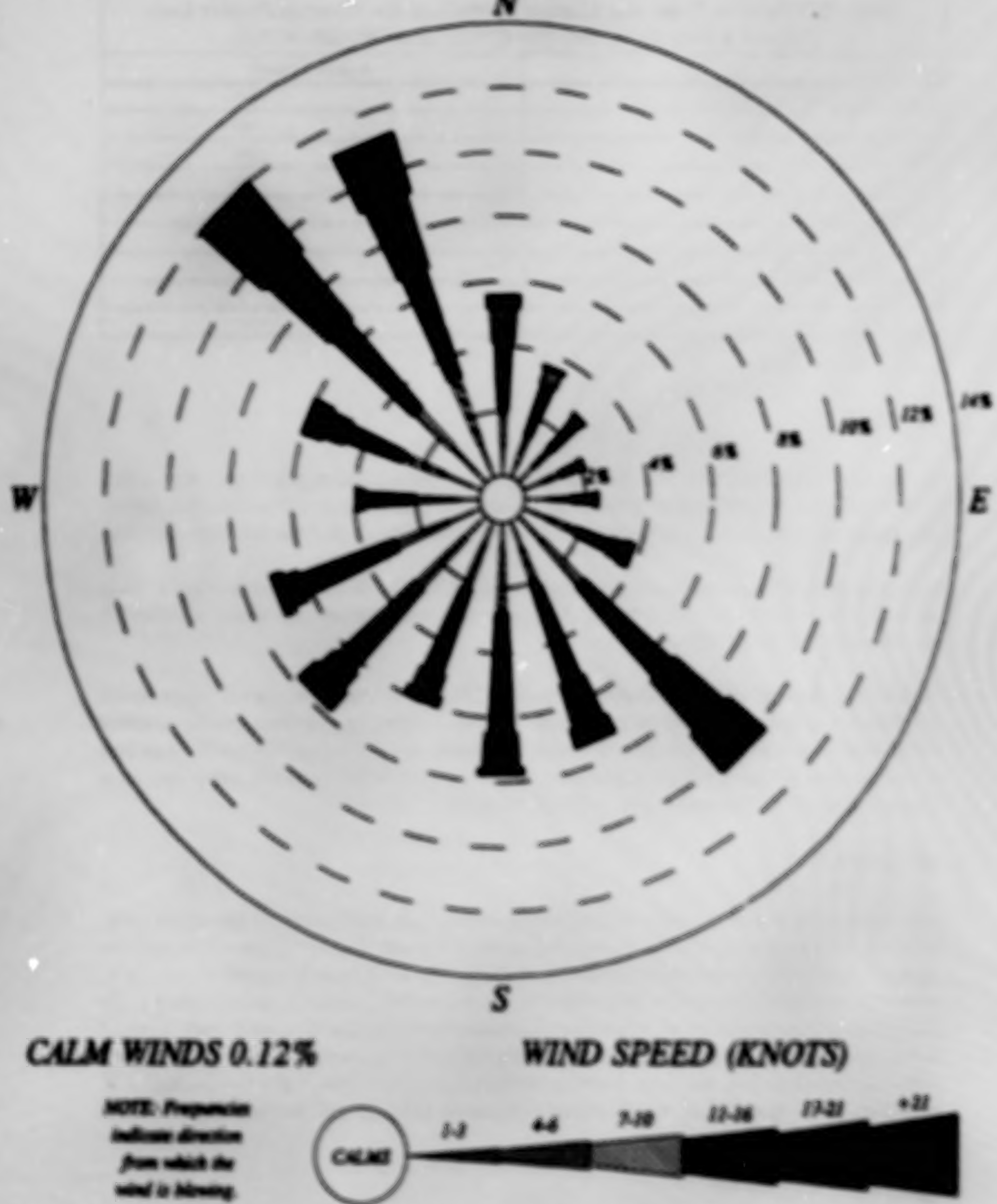
Figure 3-1

Hampshire Energy

January 1-December 31; Midnight-11 PM



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National and State of Wyoming Ambient Air Quality Standards have been developed to determine the maximum concentrations of a pollutant in the air to protect the public health and welfare with an adequate degree of safety. The pollutants of concern for the Wyodak CBM project are nitrogen dioxides (NO_2), carbon monoxide (CO), and inhalable particulates with an aerodynamic diameter of less than 10 microns (PM_{10}). The standard established for nitrogen dioxide (NO_2), shown in Table 3-11, is 100 µg/m³ as an annual average. The standards established for CO are 40,000 µg/m³ as a one-hour maximum and 10,000 µg/m³ as an eight-hour maximum. PM_{10} has an annual average standard of 50 µg/m³ and a maximum 24-hour value of 150 µg/m³.

Table 3-11 National and Wyoming Air Quality Standards			
Air Pollutant	Averaging Period	Wyoming AAQS (µg/m³)[b]	NAAQS[a] (µg/m³)[b]
(PM_{10})[c]	24-hour[d]	150	150
	annual[e]	50	50
Nitrogen dioxide	annual[e]	100	100
Sulfur dioxide	3-hour[d]	1,300	—
	24-hour[d]	260	365
	annual[e]	60	80
Carbon monoxide	1-hour[d]	40,000	40,000
	8-hour[d]	10,000	10,000

[a] National ambient air quality standard
[b] µg/m³ = micrograms per cubic meter
[c] Respirable particulate matter less than 10 microns in diameter which can penetrate deep into the lungs and cause health problems.
[d] May not be exceeded more than once per year
[e] Arithmetic mean may not be exceeded

The air quality of the project area is generally good, especially considering the level of mining development and oil and gas operations within and near the area. PM_{10} has been monitored continuously at the School Administration Building in Gillette, Wyoming since 1991. The Gillette data is representative of the project area because it is very close to the geographical center of the project area and is close to many of the existing sources of pollutants. PM_{10} was also monitored at the same location from 1985 through 1987.

The terrain in the project area has low topographic relief. There are few physical constraints to pollutant dispersal. Pollutants are likely to disperse freely in all directions. Though there are few topographical obstructions that hamper pollution dispersion, the area frequently experiences temperature inversions caused by low mixing heights and low wind speeds that hinder pollutant dispersion below mixing heights (PEDCo 1983).

Visibility of more than 60 miles is common in the project area and has been documented (USDI BLM 1995b). Significant reductions in visibility are related to weather conditions associated with high relative humidity, such as fog, haze, rain, and snow.

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As shown on Table 3-12, the PM_{10} annual average ambient concentration ranged from 16.1 micrograms per cubic meter ($\mu g/m^3$) to 17.7 $\mu g/m^3$ during 1991-1997. These values are 34 percent and less of the applicable annual average standard of 50 $\mu g/m^3$ (Table 3-11). Generally, the maximum 24-hour values have been less than 30 percent of the applicable standards. The highest 24-hour value during 1997 was 120 $\mu g/m^3$ associated with a period of high dust generated on unpaved roads. The second highest value during 1997 was only 27 $\mu g/m^3$.

Table 3-12
Wyodak Project Area Gillette Ambient Pollutant Concentration Data

Year	PM_{10} Annual Mean ($\mu g/m^3$)	PM_{10} 24-hour Maximum ($\mu g/m^3$)	Year	NO_2 Arithmetic Average ($\mu g/m^3$)	Black Thunder Mine	Belle Ayr Mine
1986	18.2	36	1975	6		
1987[1]	28.0	42	1976	4		
1991	17.7	27	1977	4		
1992	16.1	34	1978	11		
1993	17.2	36	1979	11		
1994	16.4	34	1980	12		
1995	16.1	75	1981	14		
1996	16.3	46	1982	11		
1997	16.8	120[2]	1983[3]	17		
			1996[4]	13	13	16
			1997[5]	28	23	33

[1] Monitoring discontinued July 1987. Reactivated September 1991.

[2] Road dust impact. Second highest value in 1997 was 27 $\mu g/m^3$.

[3] Monitoring discontinued December 1983. Reactivated March 1996 to April 1997.

[4] 1996 arithmetic average March to December.

[5] 1997 Arithmetic average January to April.

Source: WDEQ 1997

The NO_2 monitoring was discontinued after 1983 at Gillette. The WDEQ re-activated the monitoring program at Gillette in March 1996. The average for the entire period was 16.5 $\mu g/m^3$. The WDEQ discontinued the monitoring in May 1997. During this same period, NO_2 data were also collected at the Belle Ayr Mine and the Black Thunder Mine (Figure 3-2). The period averages for these mines were consistent with the Gillette data. The average for the entire period at the Black Thunder Mine was 15.6 $\mu g/m^3$, while the Belle Ayr data showed an average of 19.4 $\mu g/m^3$.

SOILS

A general soil association map for Wyoming has been published in a digital format by the U. S. Department of Agriculture's (USDA) Natural Resources Conservation Service (NRCS). The State Soil Geographic Database (STATSGO) (USDA NRCS 1995) was designed primarily for regional, multistate, river basin, state, and multi-county resource planning, management and monitoring.

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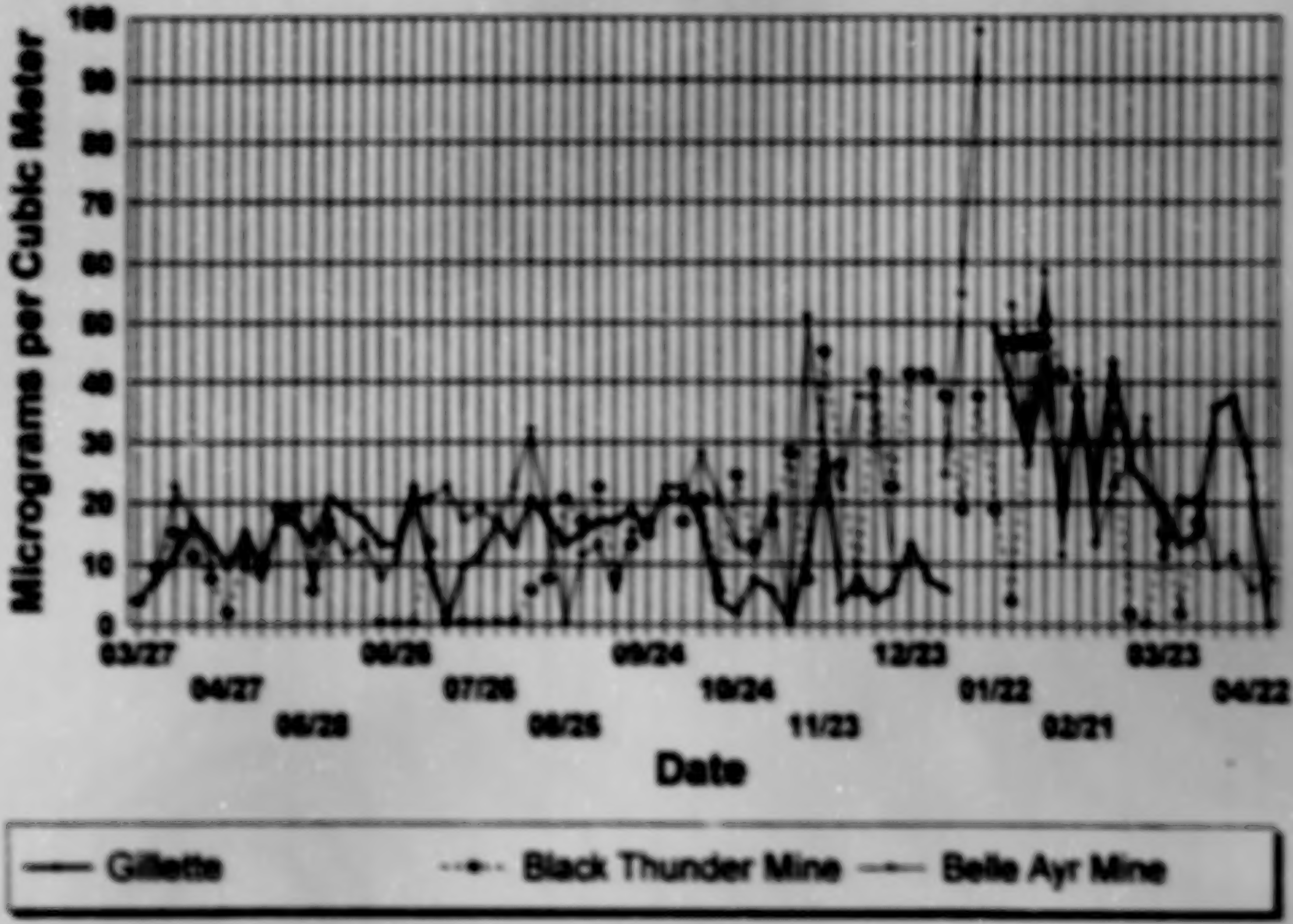
Figure 3-2

NO2 Monitoring at Gillette, Wyoming

March 96 to April 97

Source: Bob Schick, WY DEQ



STATSGO is intended to give a general overview of soils distribution and occurrence in the planning area, and is not suitable for site specific evaluations. More detailed information is available from the NRCS office in Gillette.

The distribution and occurrence of soils can be highly variable and is dependent on a number of factors including slope, geology, vegetation, climate and age. The general soils information presented in the STATSGO database is summarized below in **Table 3-13** and soil unit mapping for the project area is presented on **Map 3-1**. Twenty-four general map units (associations) comprised of 38 soil series are present in the area. The percentage of the project area occupied by each map unit also is included in the table.

Table 3-13
General Soils Information - Areal Extent of Soil Units

STATSGO Map Unit	Map Unit Name	Percent of Area
WY004	Haverson - Glenberg - Bone	0.4
WY044	Havre - Hanly - Glendive	<0.1
WY045	Cabbart - Yawdim - Thurlow	0.5
WY046	Cabba - Ringling - Yawdim	1.9
WY047	Draknab - Arvada - Bidman	0.1
WY048	Riverwash - Haverdad - Clarkelen	1.5
WY049	Shingle - Renohill - Forkwood	0.1
WY050	Shingle - Taluce - Kishona	22.2
WY051	Wyarno-Hargreave-Maskee	1.1
WY082	Renohill - Shingle - Parmleed	0.3
WY124	Platsher - Kishona - Hiland	6.7
WY125	Shingle - Theedle - Wibaux	0.1
WY126	Hiland - Vonalee - Maysdorf	10.0
WY127	Kishona - Shingle - Theedle	2.0
WY128	Renohill - Cushman - Cambria	10.5
WY129	Bidman - Parmleed - Renohill	7.6
WY130	Renohill - Bidman - Ulm	21.0
WY203	Clarkelen - Draknab - Haverdad	<0.1
WY206	Wibaux - Rock Outcrop - Shingle	0.3
WY207	Hiland - Bowbac - Tassel	1.6
WY208	Shingle - Samday - Hiland	1.4
WY209	Hiland - Shingle - Tassel	1.6
WY210	Ulm - Renohill - Shingle	0.2
WY211	Shingle - Tassel - Rock Outcrop	0.8

The predominant soil mapping units based on acreage within the proposed project area are:

- WY050 Shingle-Tassel-Kishona (22.2 percent)
- WY130 Renohill-Bidman-Ulm (21.0 percent)
- WY128 Renohill-Cushman-Cambria (10.5 percent)
- WY126 Hiland-Vonalee-Maysdorf (10.0 percent)
- WY125 Shingle-Theedle-Wibaux (8.1 percent)
- WY129 Bidman-Parmleed-Renohill (7.6 percent)
- WY124 Platner-Kishona-Parmleed (6.7 percent)

The area occupied by these seven soil map units comprises 86 percent of the project area. The remaining 17 map units occupy 14 percent of the project area.

Key soil characteristics related to erosion and salinity, and the soil's rating of suitability for use in reclamation are presented by soil series for each of the seven dominant soil mapping units shown in **Table** 3-14.

Most of the soils comprising the seven predominant soil mapping units in the project are susceptible to accelerated erosion if disturbed. Slope and K-factor are factors that are used in the estimation of soil erosion potential due to water runoff. Steeper slopes of ten to fifteen percent or greater and higher K-factors of 0.37 or greater are typically associated with higher potentials for accelerated erosion. The steeper the slopes occupied by the soils, the higher the potential for accelerated erosion, loss of soil, and stream sedimentation.

Hydrologic soil groups are used in watershed planning to estimate runoff from rainfall. The hydrologic group is based on the infiltration rate of a soil after prolonged wetting. There are four hydrologic groups (A, B, C, D). Runoff potential for soils ranges from lowest (Group A) to greatest (Group D).

Wind erosion groups are based on soil texture, and relate how susceptible a soil is to wind erosion. Nine groupings have been developed (1, 2, 3, 4, 4L, 5, 6, 7, 8); the lower the number, the greater the risk of wind erosion. Group 1 contains sand, which is highly susceptible to wind erosion, and group 8 contains very wet or stony soils which are not subject to wind erosion. The sandier soils in the project area have a moderate potential for wind erosion and associated soil loss (**Table** 3-14).

Salinity levels for the predominant soils in the project area (**Table** 3-14) are low to moderate (less than 2 mmhos/cm to 8 mmhos/cm). Natural Resource Conservation Service (NRCS) mapping provides supporting evidence of the mostly low soil salinity levels in the project area.

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Table 3-14
Project Area Soil Series Characteristics

Map Unit	Major Soil Series	Surface Texture	Slope Range (%)	K-factor	Hydrologic Group	Wind Erosion Group	Salinity/ conductivity	Reclamation Suitability
[illegible]	[illegible]	loam	[illegible]	.37	B	4L	0-8	fair
	Shingle	loam	[illegible]	.26	D	4L	0-2	fair
	[illegible]	sandy loam	[illegible]	.28	D	3	0-2	fair
[illegible]	[illegible]	loam	[illegible]	.28	C	3	0-4	fair
	[illegible]	loam	[illegible]	.37	B	4L	0-8	fair
	[illegible]	sandy loam	[illegible]	.21	B	3	0-4	fair
[illegible]	Shingle	clay loam	[illegible]	.26	D	4L	0-2	fair
	Theedle	loam	[illegible]	.37	B	4L	0-8	fair
	[illegible]	sandy loam	[illegible]	[illegible]	C	4	0-2	unsuitable
[illegible]	[illegible]	sandy loam	[illegible]	.21	B	3	0-4	fair
	[illegible]	sandy loam	[illegible]	.28	B	3	2-4	fair
	[illegible]	sandy loam	[illegible]	.37	B	3	0-2	fair
[illegible]	Renohill	clay loam	[illegible]	.37	C	4	0-4	fair
	Cushman	loam	[illegible]	.26	B	3	0-2	good
	Cambria	loam	[illegible]	.37	B	3	0-2	fair
[illegible]	[illegible]	fine sandy loam	[illegible]	.28	C	4	0-2	fair
	[illegible]	loam	[illegible]	.26	C	3	0-2	fair
	Renohill	clay loam	[illegible]	.37	C	4	0-4	fair
[illegible]	Renohill	clay loam	[illegible]	.37	C	4	0-4	fair
	[illegible]	loam	[illegible]	.28	C	4	0-2	fair
	Ulm	clay loam	[illegible]	.37	C	4	0-4	fair

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

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Assuming consistency among playa soil salinity levels among Converse, Campbell, Johnson, and Sheridan Counties, the majority of playa bottoms in the project area should not have elevated levels of soil salinity. Although salts may not have accumulated in the area's playa bottoms, higher salinity levels (greater than 8 mmhos/cm) are present in some clayey alluvial soils (USDA SCS 1986). These saline soils will likely occupy areas of minor extent on toe slopes, alluvial fans, and stream terraces throughout the project area.

The suitability for use in reclamation of most of the dominant soils in the project area ranges from "good" to "fair" (USDA FS 1979) (**Table 3-14**). Only the Wibaux soil series of the Shingle-Theedle-Wibaux map unit poses any limitations to reclamation. High coarse fragment content combined with limited volume of soil material, due the soil being shallow, are the main factors leading to the classification as "unsuitable."

VEGETATION RESOURCES

The vegetation within the project area consists of species common to eastern Wyoming. Mixed grass prairie and Wyoming Big Sagebrush are co-dominant vegetation types, although portions of each have been replaced by either irrigated or dry crop agriculture. Several other less common vegetation types also occur within the project area. Intact ponderosa pine communities are present in the northern portions of the project area and riparian areas are found along several of the perennial streams within the area. This latter vegetation type represents a small but diverse community. The composition of these relatively lush areas varies widely, ranging from wooded areas dominated by cottonwood, to shrubby areas dominated by willow, to areas which are purely grassland in nature (Clark 1987). Wetlands also are present, and are discussed in separately in this chapter.

WETLANDS

Wetlands are landscape features that are delineated on the basis of specific soil, vegetation, and hydrologic conditions. Wetlands are defined as areas typically flooded or saturated frequently enough, and long enough, with surface water or groundwater, that these areas support mostly vegetation adapted for growth in soils that are saturated under normal circumstances (40 CFR 230 and USDI BLM 1996b). Wetlands typically include swamps, marshes, bogs and similar areas. Waters of the U.S. is a collective term for all areas subject to regulation by the U.S. Army Corps of Engineers (COE) under Section 404 of the Clean Water Act. Wetlands occurring within waters of the U.S., including intermittent and ephemeral draws, creeks and rivers, playa lakes, and wetlands within the project area, are jurisdictional areas where the discharge of dredge and fill material is regulated by the COE. Adding produced water to and of itself, or subsequently reducing or eliminating the flow of produced water, to a wetland or other waters of the U.S. is not an activity regulated by the COE if the activity does not include a discharge of fill material into waters of the U.S. (**Appendix A**).

Several types of wetland systems are present within the project area. Like the riparian areas, the areal extent of these wetland systems is not indicative of their significance. While limited in size, the vegetation in these environments is highly productive and diverse, and provides habitat for many wildlife species.

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Further, the systems as a whole play important roles in controlling flood waters, recharging groundwater, and filtering pollutants (Niering 1985).

Riverine wetlands, defined by their close proximity to perennial streams, occur sporadically along several of the drainages within the project area. These areas are supported not only by the groundwater associated with the stream, but by periodic flooding events, and by splash-back from stream flow. Willow (*Salix exigua*, *S. amygdaloides*), scouring rush (*Equisetum* spp.), sedges (*Carex* spp.), and rushes (*Juncus* spp.) are common species within these environments (USDI BLM 1996d and USDA FS 1987).

Depressional areas which are naturally subirrigated support palustrine wetlands. These wetlands are commonly referred to as wet meadows and support a variety of lush plant life. Common species are sedges, rushes, cordgrass (*Spartina* spp.), mint (*Mentha* spp.) and buttercup (*Ranunculus* spp.). Depressional areas that hold water may support lacustrine wetlands. When natural, these wetland areas are called playa lakes, however, manmade structures such as stock ponds also may support these systems. Cattails (*Typha* spp.) and bulrush (*Scirpus* spp.) often are the most common species in these systems, although lady's thumb (*Polygonum* spp.), verbena (*Verbena* spp.) and milkweed (*Asclepias* spp.) also may occur (USDI BLM 1996d, USDA FS 1987).

The recent approval of CBM development in the project area (as documented in the Wyodak Final EIS and ROD) has resulted in an increase in disturbance to wetlands. Because surface disturbance within 500 feet of surface water generally is prohibited for most of the project's facilities, disturbance is limited in distribution and areal extent. However, the ongoing construction of access roads and pipelines is resulting in the short- and long-term disturbance of wetlands and riparian areas where the roads cross these features.

Additionally, the discharge of produced waters from the new wells onto the ground surface may be facilitating the expansion of existing wetlands. The consistent discharge of produced water into drainages may result in the expansion of wetlands experiencing the increase in discharge. Although likely to occur over the life of the project, the distribution and areal extent of this expansion are unknown.

WILDLIFE AND FISHERIES

Wildlife species that inhabit the project area include big game, predators, small mammals, raptors, waterfowl, and upland gamebirds. Aquatic resources in the area are limited and are restricted to the Belle Fourche, Powder, Little Powder, and Cheyenne rivers.

Big game species include antelope (*Antilocapra americana*), white-tailed deer (*Odocoileus virginianus*), mule deer (*Odocoileus hemionus*), and elk (*Cervus canadensis*). Both antelope and mule deer are expected to occur throughout the project area. White-tailed deer typically are restricted to wooded drainages within the area.

The WGFD has identified antelope winter, winter/yearlong, and yearlong ranges throughout the area. Winter range is that area where a population or portion of a population uses the documented suitable habitat sites within the range annually, in substantial numbers during the winter period. The winter period is generally from December 1 through April 30. Winter/yearlong range is that area where a population or portion of a population makes general use of the documented suitable habitat within this range on a year-round basis. But during the winter (December 1 through April 30), there is a significant influx of additional animals into the area from other seasonal ranges. Yearlong range is that area where a population or portion of a population makes general use of the suitable documented habitat within the range on a year-round basis, with the exception of severe conditions which may force animals to leave the area (USDI BLM undated).

Both yearlong and winter white-tailed deer range has been identified in the project area. The definition of each of these range types is the same as was described for antelope.

Mule deer yearlong and winter/yearlong range occurs throughout the project area. The description of these ranges is the same as was described for antelope and white-tailed deer.

Elk occur in the northwest portion of the project area on yearlong and crucial winter/yearlong range and calving areas. This herd is the Fortification elk herd, and consists of approximately 200 to 300 animals. Elk within the herd generally are restricted to the Fortification Creek Wilderness Study Area (WSA) and surrounding areas in the western portion of the study area (USDI BLM 1999a).

Predators expected to occur in the area include coyotes (*Canis latrans*), badgers (*Taxidea taxus*), raccoons (*Procyon lotor*), bobcats (*Felis rufus*), and red fox (*Vulpes vulpes*). These species are anticipated to occur within all habitat types in the project area. Swift fox (*Vulpes velox*) is a rare species which may occur within the project area. A scent box survey of the general project area, found the presence of swift fox within the project area. However, no direct observations of swift fox have been made (USDI BLM 1999a).

The most commonly occurring small mammals within the project area may include prairie voles (*Microtus ochrogaster*), white-footed deer mouse (*Peromyscus maniculatus*), bushy-tailed woodrat (*Neotoma cinerea*), black-tailed prairie dogs (*Cynomys ludovicianus*), and desert cottontails (*Sylvilagus audubonii*). A total of six black-tailed prairie dog colonies have been identified within the project area. However, additional colonies are expected to occur within the project area.

Raptor species occurring seasonally in the project area include red-tailed hawks (*Buteo jamaicensis*), golden eagles (*Aquila chrysaetos*), Swainson's hawks (*Buteo swainsoni*), ferruginous hawks (*Buteo regalis*), prairie falcons (*Falco mexicanus*), great horned owls (*Bubo virginianus*), burrowing owls (*Athene cunicularia*), American kestrels (*Falco sparverius*), and Northern harriers (*Circus cyaneus*). Both bald eagles (*Haliaeetus leucocephalus*) and rough-legged hawks (*Buteo lagopus*) occur in the area during the winter. However, no rough-legged hawk or bald eagle nests have been documented to occur within the area. Raptor surveys have been conducted within the area during previous seasons and in 1998 aerial surveys of about 90 percent of the project area were conducted in cooperation with WGFD. **Tables 3-15a, 3-15b, and 3-15c** indicate the species and status of nests located during these surveys. Previous reports indicated that the number of active ferruginous hawk and golden eagle nests had decreased within the project area (USDI BLM 1995b). Typical nesting periods for raptor species are March-July. During the 1998 study, ferruginous hawk production within the area was 2.29 young/successful nest (7 of the 14 active nests that were checked for productivity failed). A total of 20 additional active ferruginous hawk nests with a total of 37 young were located during the final week of the nest survey for a production of 1.85 young/active nest. Golden eagle production in the project area was 1.47 young/active nest.

Table 3-15a
1998 Nest Status

Species	Active[1]	Inactive[2]	No. of Young[3]
Ferruginous Hawk	48	249	73
Swainson's hawk	15		10
Red-tailed hawk	54	43	22
Golden eagle	19	10	17
Great Horned Owl	6		9

[illegible]

Table 3-15b
1997 Nest Status

Species	Active[1]	Inactive[2]	No. of Young[3]
Ferruginous hawk	5	16	16
Swainson's hawk	3	1	0
Red-tailed hawk	9	4	2
Golden eagle	2	1	0

[illegible]

Table 3-15c
1996 Nest Status

Species	Active[1]	Inactive[2]	No. of Young[3]
Ferruginous hawk	9	16	4
Swainson's hawk	0	0	0
Red-tailed hawk	0	0	0
Golden eagle	2	13	1

[1] [illegible]
[2] [illegible]
[3] [illegible]
[illegible]

Numerous songbirds occur within the project area. The diversity and density of these species vary by season. Typical species include horned lark (*Eremophila alpestris*), loggerhead shrike (*Lanius ludovicianus*), sage thrasher (*Oreoscoptes montanus*), mountain bluebird (*Sialia currucoides*), western meadowlark (*Sturnella neglecta*), and vesper sparrow (*Pooecetes gramineus*).

Gamebirds within the project area include sage grouse (*Centrocercus urophasianus*), sharp-tailed grouse (*Tympanuchus phasianellus*), mourning doves (*Zenaida macroura*), ducks, and geese. Numerous grouse leks have been identified within the project area. In addition, a two-mile buffer zone around each lek site has been identified. This two-mile buffer represents an area where disturbance is restricted from February 1 through July 31. A comparison was made of the number of sage grouse strutting/breeding grounds (leks) to the total number of grounds identified in the project area since 1980. This was done in an attempt to identify cumulative impacts that may be occurring in the area as a result of human activity and habitat disturbance or loss. There were 64 historic sage grouse leks identified in the area since 1980, only 26 leks have been active in the last five years.

"Limited existing information is available for use in characterizing aquatic habitats in perennial receiving waters, flow regimes, and anticipated stream erosion downstream of the discharge points or the proposed discharges of CBM produced water. A comparison of 1990s and 1960s fish survey data from the Missouri River basin indicated that the sturgeon chub has a stable or increasing distribution (Patton et al. 1998). This survey was restricted to native warm-water species in non-montane regions. An estimated 40 to 50 percent of the fish species surveyed indicated a possibility of declining distributions (Patton et al. 1998). Two aquatic habitat types were common among the species with declining distributions indicated in the study: turbid rivers having silt and sand substrates, and small-to medium-sized streams having relatively cool, clear water, and preferably having gravel substrates for spawning. Patton et al. (1998) suggested that reservoirs and diversion dams may have stabilized flows and reduced silt loads in rivers, and that land management and irrigation practices may have increased turbidity and siltation in many small- to medium-sized streams.

Aquatic species are generally restricted to the Belle Fourche, Cheyenne, and Powder rivers. Species within the Powder River include goldeye (*Hiodon alosoides*), common carp (*Cyprinus carpio*), creek chub (*Semotilus atromaculatus*), flathead chub (*Platygobio gracilis*), longnose dace (*Rhinichthys cataractae*), sand shiner (*Notropis stramineus missuriensis*), plains minnow (*Hybognathus placitus*), fathead minnow (*Pimephales promelas*), shorthead redhorse (*Moxostoma macrolepidotum*), white sucker (*Catostomus commersoni*), black bullhead (*Ameiurus melas*), channel catfish (*Ictalurus punctatus*), sturgeon chub (*Macrhybopsis gelida*), stonecat (*Noturus flavus*), longnose sucker (*Catostomus catostomus*), plains killifish (*Fundulus zebrinus*), quillback (*Carpiodes cyprinus*), river carpsucker (*Carpiodes carpio*), rock bass (*Ambloplites rupestris*), sauger (*Stizostedion canadense*), shovelnose sturgeon (*Scaphirhynchus platorynchus*), red shiner (*Cyprinella lutrensis*), and western silvery minnow (*Hybognathus argyritis*). Species within the Little Powder River are similar to the Powder River and also include green sunfish (*Lepomis cyanellus*). Within the Belle Fourche River the following species are known to occur: common carp, creek chub, shorthead redhorse, black bullhead, channel catfish, (*Ictalurus punctatus*) flathead chub, fathead minnow, longnose dace, plains minnow, river carpsucker, sand shiner, white sucker, red shiner, and green sunfish. Species within the Cheyenne River are similar to the other rivers and also may include plains topminnow (*Fundulus sciadicus*), and plains killifish.

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With the recent approval of CBM development in the project area (as documented in the Wyodak Final EIS and ROD), wildlife and their habitats have been experiencing disturbances as the CBM wells and ancillary facilities are constructed and put into operation. As this project proceeds, as many as 26,491 acres of the project area have or will be disturbed for the CBM wells and ancillary facilities. Most of this disturbance (59 percent) would be reclaimed within one year of the disturbance's initial occurrence. Thus, disturbance of these 15,763 acres would be short term in nature. Over the long-term, wildlife habitats on about 10,798 acres would remain disturbed after the short-term disturbances have been fully reclaimed.

SPECIAL STATUS SPECIES

Contact between the BLM and the U.S. Fish and Wildlife Service (USFWS) has identified the following three federally listed threatened or endangered species as potentially occurring within the project area: the endangered black-footed ferret (*Mustela nigripes*), threatened bald eagle, and the endangered Ute-ladies' tresses (*Spiranthes diluvialis*). The mountain plover (*Charadrius montanus*) is proposed for listing as threatened. In addition to the threatened and endangered species, three candidate species have been identified as potentially occurring within the area: the swift fox (*Vulpes velox*), the black-tailed prairie dog (*Cynomys ludovicianus*), and sturgeon chub (*Macrhybopsis gelida*). The black-tailed prairie dog is a candidate for threatened status to be reviewed annually by the USFWS. The black-tailed prairie dog could move up the priority list, if the species continues to decline or if conservation efforts fail, or it could be removed as a candidate species if its situation improves. In addition to the federally listed species, 27 species have been designated by the FS as sensitive species that occur or potentially may occur in the project area (USDA FS 1998). The following is a brief description of each species as well as the potential habitat each species utilizes.

Black-footed Ferret

Black-footed ferrets are primarily nocturnal animals that are nearly always associated with prairie dogs. Prairie dogs are the ferret's source of prey and prairie dog burrows provide dens and rearing areas for ferret young. A single black-tailed prairie dog colony of 32 ha (80 acres) or a complex of smaller colonies occurring within a circle with a 7-km (4.3-mi) radius that totals 32 ha is considered to be the minimal size necessary to constitute potential habitat for the black-footed ferret (USFWS 1989a). At least six prairie dog colonies have been identified within the project area. However, additional colonies are anticipated to occur within the project area.

The development of CBM that was approved in the Wyodak ROD and is occurring in the project area is not expected to alter the affected environment for black-footed ferrets. In general, the facilities are linear in nature and easily moved to avoid potentially suitable habitats. However, where facilities could not be moved to avoid potentially suitable habitats, surveys of the prairie dog colonies that meet the minimum requirements to be considered potentially suitable habitat for the black-footed ferret would be conducted to ensure ferrets do not inhabit the colonies.

Bald Eagle

Feeding areas, diurnal perches, and night roosts are fundamental elements of bald eagle winter range. Although eagles can fly as far as 24 km (15 mi) to and from these elements, they primarily inhabit areas where all three elements are available in comparatively close proximity (Swisher 1964).

Although eagle presence in winter is not directly correlated with open water (Swisher 1964), eagles usually occur near large rivers and lakes (Sprunt and Ligas 1963). Because the eagle's use of water areas generally decreases as ice cover increases (USDI BLM 1980b), open water is considered an important feature of their winter habitat (USDI BLM 1973). Eagles are particularly attracted to large bodies of water downstream from hydroelectric dams where dead or dying fish or waterfowl are readily accessible (Cooksey 1962, Ingram 1965).

Food availability is probably the single most important factor affecting winter eagle distribution and abundance (Steenhof 1976). Fish and waterfowl are the primary food sources where eagles occur along rivers, lakes, streams, and dams. In some regions, carrion can also be an important food source.

Perches are an essential element in the bald eagle's selection of foraging areas, because they are necessary for hunting and resting. Ice, driftwood, fence posts, cliffs and rock outcrops, gravel bars in rivers, shorelines, telephone poles, open hillsides, and trees are used as perches. However, dead deciduous trees are preferred (Stalmaster and Newman 1979).

Roosts are areas used for sleeping and providing protection from winter storms. Usually, eagles leave the roost for feeding areas in early morning and return in the evening. However, during severe weather they may remain at the roost all day.

Roosts may be used by individual birds or small to large groups of birds. Also, roosts can be used in successive years. Large, live trees of dominant or co-dominant species that occur in sheltered areas (e.g., in the protected slopes of a valley or ravine or behind a bluff) are preferred (Lish 1975).

Three bald eagle winter roosts have been identified in the project area. One is located in the northern edge of the project area, one is located along the southwestern edge of the project area, and the other is along the southern edge of the project area (USDI BLM 1998c).

With implementation of the Wyodak project, relatively minor amounts of foraging habitats for the bald eagle in the project area is being disturbed by the construction of CBM wells and ancillary facilities. Although almost 60 percent of this minor disturbance would be reclaimed within one year of initial disturbance, some of the disturbance will remain for the long term. Control of access to the winter roosts during the winter is expected to minimize effects to bald eagles using the three known roosts present in the project area.

Ute-ladies' Tresses Orchid

The Ute-ladies' tresses orchid occurs primarily in wetland areas where vegetation is relatively open, not overly dense or overgrown (USFWS 1989b, Jennings 1989 and 1990). A few populations in eastern Utah and Colorado are found in riparian woodlands, but the orchid seems generally intolerant of shade, preferring open, grass and forb-dominated sites instead. Most occurrences are along riparian edges, gravel bars, old oxbows, and moist to wet areas near freshwater lakes or springs (USFWS 1991). Plants usually occur in small scattered groups occupying relatively small areas with the riparian system (Stone 1993).

Ute-ladies' tresses are endemic to moist soils in mesic or wet meadows near springs, lakes, or perennial streams. The elevational range of the species is 4,300 to 7,000 feet (Stone 1993). This orchid may require "permanent sub-irrigation", indicating a close affinity with floodplain areas where the water table is near the surface throughout the growing season, continuing into late summer or early autumn.

The development of CBM that was approved in the Wyodak ROD and is occurring in the project area is not expected to alter substantively the affected environment for the Ute-ladies' tresses orchid. In general, the facilities are linear in nature and easily moved to avoid potentially suitable habitats. However, where facilities could not be moved to avoid potentially suitable habitats, surveys of the wetlands that meet the minimum requirements to be considered potentially suitable habitat for the orchid would be conducted to ensure the species does not inhabit those wetlands.

Black-tailed Prairie Dog

The Black-tailed prairie dog is a highly social, diurnally-active, burrowing mammal. Aggregations of individual burrows, known as colonies, form the basic unit of prairie dog populations. Found throughout the Great Plains in shortgrass and mixed-grass prairie areas (Fitzgerald et al. 1994), the black-tailed prairie dog has decline in population numbers and extent of colonies in recent years. Many other wildlife species, such as the black-footed ferret (as mentioned above), swift fox, mountain plover, ferruginous hawk, and burrowing owl are dependent on the black-tailed prairie dog for some portion of their life cycle (USFWS 2000b).

The Black-tailed prairie dog was added to the list of candidate species for federal listing on February 4, 2000 (USFWS 2000a). At that time, the USFWS concluded that listing of the black-tailed prairie dog was warranted by precluded by other higher priority actions to amend the lists of threatened and endangered species. No specific date for proposal for listing was given, but the USFWS has committed to reviewing the status of the species one year after publication of the above-mentioned notice (i.e. on February 4, 2001) (USFWS 2000b).

Swift Fox

Swift fox typically inhabit short- and mid-grass prairies. In northeastern Colorado swift fox appear to prefer relatively flat to gently rolling topography. They rarely are found in gullies, washes, or canyons.

Swift fox feed on small rodents, rabbits, and birds. Jackrabbits comprise the majority of their diet, however, ground squirrels, ground-nesting birds, and prairie dogs also are included. One swift fox occurrence has been identified within the southeastern portion of the project area.

Mating occurs from late December through February. Pups are born in late March, April, or early May. Four to five pups are produced and they do not emerge until they are four to five weeks old. Dens are generally located on flat areas, or along slopes or ridges that offer good views of the surrounding area (Fitzgerald et al. 1994).

With implementation of the Wyodak project, potentially suitable habitats for the fox in the project area are probably being disturbed to some degree by the construction of CBM wells and ancillary facilities. However, the BLM is using on-site reviews conducted in response to the receipt of APDs or Sundry Notices to evaluate the site-specific situation and determine the need for special conditions to ensure potential effects on the swift fox are minimized.

Mountain Plover

Mountain plover is a small migratory bird that utilizes high, dry, shortgrass prairies seasonally. Within these habitats, areas of blue gramma (*Bouteloua gracilis*) and buffalograss (*Buchloe dactyloides*) are most often utilized. In addition, areas of mixed grass associations dominated by needle-and-thread (*Stipa comata*) and blue gramma also are utilized (USFWS 1983).

Mountain plover have been observed in prairie dog colonies on the TBNG. Nests consist of a small scrape on flat ground in open areas. Most nests are placed on slopes of less than 5 degrees, and occur in areas of buffalo grass, blue gramma, scattered cacti, and western wheatgrass (*Agropyron smithii*). These areas typically support vegetation that is less than 3 inches tall in April. Within Colorado more than half of identified nests occurred within 12 inches of old cow manure piles and almost 20 percent were found against old manure piles. In addition, nests in Montana were nearly always associated with the grazed shortgrass of prairie dog colonies (USFWS 1983).

In southwestern Wyoming, observations suggest plovers arrive on their breeding grounds as early as March 25; however, the average arrival date is April 13. Egg laying typically begins in late April with the last clutch laid in mid-June. Most clutches hatch from late March through late June, with the chicks fledging in early to late June. Once the broods hatch, plovers tend to move large distances from the nest. The birds typically beginning migrating out of the area by mid-August. However, some birds may stay until late September (USFWS 1983).

The project area may contain areas of potential habitat for the mountain plover, i.e., prairie dog towns. With implementation of the Wyodak project, potentially suitable habitats for the plover in the project area are probably being disturbed to some degree by the construction of CBM wells and ancillary facilities. However, the BLM is using on-site reviews conducted in response to the receipt of APDs or Sundry

Notices to evaluate the site-specific conditions and determine the need for special stipulations to ensure potential effects on the plover are minimized.

Sturgeon Chub

Sturgeon chub occur almost exclusively in the Missouri River drainage system. The range of this fish species encompasses the river's headwaters in Montana and Wyoming to its mouth at the Gulf of Mexico. In Wyoming, the sturgeon chub are restricted to the Lower Bighorn and Powder Rivers.

Preferred habitat is above gravel bottoms within large, turbid, fast-moving rivers. Chub are most abundant in gravel riffles, but sometimes are found in sandy bottom pools containing some gravel. Sturgeon chub usually occur in less than 3 feet of water, and eat primarily bottom-dwelling invertebrates. Chub spawn in late spring to midsummer (until late July) when water temperatures are between 65 and 72°F. Spawning occurs within shallow rapids over gravel and rock. The Powder River in Wyoming supports the largest known reproducing population of sturgeon chub.

Other Species, Including FS Sensitive Species

In addition to the federally listed species, 27 species have been designated by the FS as sensitive species that occur or potentially may occur in the part of the TBNG that is within the southern part of the project area (USDA FS 1998). FS sensitive species are those species identified by the Regional Forester for which population viability is a concern, as evidenced by either a significant current or predicted downward trend in population numbers or density, or significant current or predicted downward trend in habitat capability that would reduce a species' existing distribution. **Table 3-16** lists these species and their potential for occurrence within the project area. These species potentially occur within the TBNG.

Table 3-16
U.S. Forest Service Sensitive Species

Species **Common name (*Scientific name*)**	**Suitable Habitat**	**Potential for Occurrence Based on Suitable Habitat**
Fish		
Flathead chub (*Platygobio gracilis*)	Common in large, silty rivers east of the Continental Divide; found within the project area in Antelope creek, the Cheyenne River, and the Little Powder River.	High[1]
Plains topminnow (*Fundulus sciadicus*)	Inhabits clear streams with sand and gravel bottoms; found in the headwaters of the Cheyenne River within the project area.	Medium[2]
Reptiles and Amphibians		
Northern leopard frog (*Rana pipiens*)	Found in or near permanent water.	High

Table 3-16 (continued)
U.S. Forest Service Sensitive Species

Species **Common name (*Scientific name*)**	**Suitable Habitat**	**Potential for Occurrence Based on Suitable Habitat**
Tiger salamander (*Ambystoma tigrinum*)	Inhabits moist environments below 10,000 feet out of sun and wind; larvae may be found in streams, lakes, and ponds.	High
Milk snake (*Lampropeltis triangulum*)	Found under stones, logs, and other debris, in prairie, river bottoms, rocky hillsides, and forests.	High
Black Hills red-bellied snake (*Storeria occipitomaculata pahasapae*)	Found under debris in cottonwood-willow and ponderosa pine habitat, especially in hilly areas.	High
Mammals		
Townsend's big-eared bat (*Plecotus townsendii*)	Roosts in caves; forages over desert shrublands, pinyon-juniper woodlands, and dry coniferous forests.	High
Fringed-tailed myotis (*Myotis thysanodes pahasapensis*)	Occurs in isolated populations from the Black Hills south to Laramie; forages over grasslands, deserts, and woodlands; roosts in caves, mines, and crevices.	High
Swift fox (*Vulpes velox*)	Inhabits rolling short-grass prairie; observed within the project area.	High
Birds		
American bittern (*Botaurus lentiginosus*)	Summer resident, occurring in marshes, swamps, reedy lakes, rivers, moist meadows, and riparian thickets.	Medium
Western yellow-billed cuckoo (*Coccyzus americanus*)	Found in cottonwood or willow riparian areas.	High
Greater Sandhill crane (*Grus canadensis*)	Summer resident, occurring in open areas having shallow water with some areas of dense vegetation.	Medium
Long-billed curlew (*Numenius americanus*)	Summer resident that prefers sagebrush-grassland in open areas with few shrubs.	High
Ferruginous hawk (*Buteo regalis*)	Summer resident that nests in rock outcrops, in trees, and on the ground; known to occur within the project area.	High
White-faced ibis (*Plegadis chihi*)	Summer resident which exclusively inhabits ponds, marshes, muddy pools, stream margins and river banks.	Medium
Common loon (*Gavia immer*)	Inhabits high elevation rivers, lakes, and ponds having deep water and vegetation up to waters edge.	None[3]
Merlin (*Falco columbarius*)	Year-round resident living in open areas, coniferous forests, and deciduous woodlands along rivers.	High

Table 3-16 (continued)
U.S. Forest Service Sensitive Species

Species Common name (*Scientific name*)	Suitable Habitat	Potential for Occurrence Based on Suitable Habitat
Western burrowing owl (*Athene cunicularia*)	Summer resident which inhabits vacant prairie dog burrows in short-grass prairie areas.	High
Loggerhead shrike (*Lanius ludovicianus*)	Summer resident of upland sagebrush shrubland/grassland and pine-juniper woodlands; shrubs and lookout perches are important habitats.	High
Fox sparrow (*Passerella iliaca*)	Inhabits native riparian shrubs with adjacent coniferous forest or woodland-chaparral, aspen woodlands, and willow thickets.	Medium
Black-backed woodpecker (*Picoides arcticus*)	Lives in coniferous forests, especially ones that have burned.	None
Mountain plover (*Charadrius montanus*)	Summer resident, found in shortgrass and midgrass grasslands; prefers vegetative height under 4 inches.	High
Upland sandpiper (*Bartramia longicauda*)	Summer resident of upland grasslands with few shrubs; ground nester.	High
Baird's sparrow (*Ammodramus bairdii*)	Summer resident of upland grasslands; ground nester in open prairie.	High
Black tern (*Chlidonias niger*)	Summer resident of freshwater marshes, wet meadows, and marshy lakes; nests on floating mats of dead vegetation.	None
Lewis' woodpecker (*Melanerpes lewis*)	Summer resident of cottonwood riparian areas, ponderosa-pine, and pine-juniper coniferous forests.	Medium
Invertebrates		
Tawny-crescent butterfly (*Phyciodes batesi*)	Inhabits moist forest borders; usually found in riparian areas or around moist soil.	None

[1] High= Suitable habitat occurs within project area and species has been documented within the project area

[2] Medium= Limited amount of habitat occurs within project area, but species does occur within the project area.

[3] None= Suitable habitat does not occur within the project area

The black-tailed prairie dog is a small mammal commonly occurring within the project area. A total of six black-tailed prairie dog colonies have been identified within the project area. However, additional colonies are expected to occur within the project area.

With the level of development approved in the Wyodak Final EIS and ROD, as many as 26,491 acres of habitats for these species in the project area have or will be disturbed for the CBM wells and ancillary facilities. Most of this disturbance (59 percent) would be reclaimed within one year of the disturbance's initial occurrence. Thus, disturbance of these 15,763 acres would be short term in nature. Over the long-term, vegetation resources on about 10,788 acres would remain disturbed after the short-term disturbances have been fully reclaimed.

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CULTURAL RESOURCES

The project area supported extensive herds of bison in the prehistoric and early historic periods. The seasonal to irregular availability of water and general lack of sheltered areas discouraged large, permanent settlements. The principal local raw materials for prehistoric stone tool manufacture are porcellanite and non-volcanic glass. The latter lithic materials are byproducts of the metamorphosis of claystones by burning coal seams.

Overview of Known Cultural Resources

Cultural sites are generally defined as discrete locations of past human activity which can include artifacts, structures, works of art, landscape modifications, and natural features or resources important to tradition or history. Sites can also include extensive linear features such as trails, roads or railroads, broad areas considered as "cultural landscapes," and traditional use areas. Significant sites are defined as those sites that are listed on or eligible for the National Register of Historic Places (NRHP) under the criteria for eligibility (36 CFR §60.4), including Traditional Cultural Properties.

The study area encompasses several previous environmental assessments, overviews, and Class II sample inventories, including the South Wyodak Coal Bed Methane Project EIS (USDI BLM 1999a, b) the Gillette Coal Bed Methane Environmental Assessment (USDI BLM 1996b), the North Gillette Coal Bed Methane Environmental Assessment (USDI BLM 1996b), the Campbell and Johnson Counties Coal Bed Methane Environmental Assessment (USDI BLM 1990), the Eastern Powder River Basin Class II Inventory (Peebles 1981). There also have been numerous small to moderate investigations completed for highway improvements and for producing coal mines scattered along the eastern edge of the study area.

Although the Paleoindian and Early Plains Archaic periods are comparatively weakly represented in this region, all of the prehistoric periods, from Clovis to Protohistoric, are known from this region. Prehistoric site densities can be high in some areas, particularly along ridgetops and near larger and more reliable drainages. In the Protohistoric and early historic periods this was the territory of the Arikara, Crow, Lakota, Northern Arapaho, Northern Cheyenne, and Shoshone. Numerous confrontations between Euroamerican settlers and the latter tribal groups occurred in this area.

Fur trade presence in the Powder River Basin in the early 1800s was transient in comparison with other parts of the regions, because the fur resources of these drainages were rapidly depleted. The major emigrant trails of the 1840s and 1850s had passed south of the study area along the North Platte. With the emergence of the Montana gold fields during the 1860s, trails were developed through the study area. The Sawyer expeditions of 1864 and 1865 attempted to establish a wagon road through the Powder River Basin south of Gillette. The more southerly route of the Bozeman Trail, extending from Fort Laramie through the southwest portion of the study area, and along the eastern edge of the Bighorn Mountains, became a major route through the region for several years. Other important historic corridors within or near the study area were the Black and Yellow Trail, the Texas Cattle Trail, and the Cheyenne-Deadwood Stage Road.

Permanent settlement of any magnitude within the study area began in the 1880s. The earliest settlement was focused on livestock, but by the turn of the century coal mining had become an important element of the regional economy. Until recent decades, sheep and cattle production remained as mainstays of the regional economy, but mineral and energy development clearly has become dominant.

Results of File Search

Files searches for the Wyodak Coal Bed Methane Project were conducted through the Wyoming Cultural Records Office on June 4, 1998 and February 7, 1999, for the study area. These files searches indicated that 1,572 previous investigations are on record for the project area. Of those reports, 760 in the project area were completed prior to 1983 when statewide standards were implemented for cultural resource investigations and reporting. Since June 1998, there have been 644 new projects conducted within the project area. To date, a total of 283,550 acres have been inventoried to a 100 percent intensive (Class III) level between 1986 and 2000. This represents a total of 3.8 percent of the entire land base of Johnson, Sheridan, and Campbell Counties, although the vast majority of this inventory has been conducted in Campbell County, within the present study area. The 644 recent projects account for a total of 140,750 acres, or 49.6 percent of the current total acreage that has been inventoried at a Class III level. The increase in acreage is largely due to block survey inventories for CBM field developments, as well as several large land exchanges and coal lease surveys.

Table 3-17 lists the numbers of cultural resource sites, distribution of site types, and the numbers of significant cultural resource sites that have been formally recorded in the project area. A total of 2,157 sites have been documented in the drainage study area (1,642 prior to 1998, and 515 since 1998). Approximately 192 of those are considered eligible for, or are listed in, the NRHP.

Table 3-17
Site Types Known for Wyodak Project Area

Site Types Encoded in Data Base	Recorded Prior to 1998		Recorded Since 1998	
	Total	NRHP Eligible	Total	NRHP Eligible
Prehistoric-total	1,157	115	351	35
Lithic	813	41	180	5
Campsites & Occupations	267	66	77	17
Stone circles	44	4	67	9
Lithic sources	14	2	3	0
Alignments	1	0	0	0
Structure/lodge	1	1	1	0
Cairn, alignment	5	0	5	1

Table 3-17 (continued)
Site Types Known for Wyodak Project Area

Site Types Encoded in Data Base	Recorded Prior to 1998		Recorded Since 1998	
	Total	NRHP Eligible	Total	NRHP Eligible
Killsite/bone bed	8	1	4	2
Human bone	1	0	0	0
Rock art	1	0	1	1
Rockshelters	0	0	1	0
Vision Quest	NC	NC	1	0
Caches	NC	NC	1	0
Unknown	2	0	10	0
Paleontology	1	0	0	0
Historic-total*	527	35	120	5
Trails	2	1	1	0
Roads	29	8	3	1
Railroads	2	2	0	0
Homesteads, ranches, dugouts	267	14	43	1
Foundations	0	0	6	0
School, spec. str.	0	0	3	0
Ditches, water constructs	1	0	3	0
Historic debris	NC	NC	44	1
Sheepherder camp or campsite	16	6	31	1
Sheepherder mon.	NC	NC	1	0
Historic cairn	NC	NC	14	0
Historic mon., road marker	NC	NC	1	0
Grave, graveyard	NC	NC	1	0
Quarry	NC	NC	1	0
Construct, pit	NC	NC	11	0
Mining	7	0	0	0
Uncoded/unknown	203	5	8	1
Isolated Artifact	NC	NC	2	0
Battlefield	0	0	1	1
Hist. Graffiti	0	0	2	0
Multicomponent (a)	43	NC	41	2
Totals	**1,685**	**150**	**515**	**42**

* Historic sites are evaluated according to functional themes and contexts; these include Conservation, Exploration, Farming and Agriculture, Mining, Ranching, Transportation and Military Activity. Prehistoric and historic sites are discrete localities which may incorporate a number of functions; therefore this analysis uses descriptive, rather than functional categories.

** NC stands for "Not Coded"; this category subsumes a number of historic site types such as sheepherders camps and trash scatters which are difficult to categorize.

(a) Multicomponent sites contain both prehistoric and historic materials and should not be counted in site totals.

Approximately 70 percent of the prehistoric sites in the Wyodak project area data base are lithic (chipped stone) scatters, with an additional 26.9 percent classified as campsites, occupations, and stone circles. The pattern changes slightly in the most recently inventoried sites, with only 51.2 percent of the sites classified as lithic scatters, and 41.0 percent of the sites being occupations or stone circles. Prehistoric sites continue to be recorded twice as often as historic sites. Historic debris, homesteads, ranches and residential structural remains, and sheepherder or other temporary campsites make up the majority of historic sites. Diagnostic artifacts, hearths, and stratified occupations contribute to significance in prehistoric sites, which become eligible for the NRHP under Criterion "d" (preservation of important information); historic sites usually meet Criteria "a", "b", or "c" (association with important persons or events; characteristic of types, periods, or methods of manufacture; or possessing high artistic values). Traditional Cultural Properties must meet the criteria for eligibility, plus preserve a cultural continuity with the social groups that value them.

Native American Consultation

Recent legislation requires consultation with interested Native American tribal groups. Within the study area, these tribal and cultural groups are considered to include the Crow, Northern Cheyenne, Arapaho, Shoshone, Arikara, and western Sioux (Lakota) tribes, although the Gros Ventre, Blackfeet, Kiowa, and other groups are known to have traversed the area. As part of the consultation process, copies of the EA will be sent to the designated cultural officer of each tribe for review and comment. At this time, no Native American special interest sites have been formally identified within the study area. Should previously unknown Traditional Cultural Properties be identified as part of this consultation or in the course of project development, BLM is required to consider the concerns of those Native American tribes most likely to be involved with these locations.

LAND USE AND TRANSPORTATION

Land ownership, shown on **Map 1-2** consists primarily of private lands intermingled with federal and state lands. Isolated tracts of BLM-administered lands, state-owned lands, and the TBNG are located within the study area.

Within the project area, approximately 11.7 percent of surface ownership is federal (USDI BLM 1999b) and consists primarily of lands administered by the BLM and FS. Federal lands administered by the BLM and FS in the project area consist of numerous isolated islands and tracts of land surrounded by private lands. In Campbell, Johnson, and Sheridan counties, BLM lands within the project area are administered by Buffalo Field Office (BFO). BLM lands in Converse County are administered by the Casper Field Office.

The BLM is responsible for the balanced management of public lands and resources so that their various values are considered in a combination that will best serve the needs of the American people. The TBNG is administered by the Medicine Bow – Routt National Forest. The FS is responsible for the balanced management of national forests and grasslands and resources so that their various values are considered in a combination that will best serve the needs of the American people. Management by the BLM and FS is based upon the principles of multiple use and sustained yield.

The 12,419 acre Fortification Creek Wilderness Study Area (WSA) situated northwest of Gillette is included within the project area. This portion of the northern Powder River Breaks is managed to maintain the area without impairment of its wilderness values, in accordance with interim BLM management policy, pending congressional action that determines its management policies and standards (USDI BLM 1985). Only a small portion of the WSA, just west of Wild Horse Creek and the main railroad line connecting Gillette and Sheridan, is within the project area. Fortification Creek, within the central portion of the WSA, is located west of the project area.

The mineral estate (mineral ownership) of lands within the project area is federally owned, at least in part, throughout most of the area. Many privately owned lands have a mineral estate that is, at least in part, federally owned. Federal ownership of oil and gas totals about 1,293,000 acres (56 percent) of the project area. Federal ownership of coal totals about 2,053,000 acres (89 percent) (**Maps 1-3 and 1-4**). All of the federal mineral estate within the project area is open to locatable mineral exploration and development.

The State of Wyoming owns an estimated 6.2 percent of the land surface and mineral estate within the project area. All of the state-owned lands in the project area are State Trust lands that are available for mineral and agricultural leasing, timber leasing and sales, and public recreation. State Trust lands generate revenues that are reserved for the benefit of designated beneficiaries. These beneficiaries are the common (public) schools, universities, and other public institutions in Wyoming.

The remaining 82.1 percent of land ownership in the project area is private, as shown on **Map 1-2**.

The primary land cover type in the project area is rangeland (mixed grass cover type and Wyoming Big Sagebrush type). Other land cover types in the project area include cropland (irrigated and dryland), human settlements (Gillette and Wright), and mining operations. Livestock grazing, oil and gas production, clinker quarrying, and coal mining are the primary uses of the rangeland cover type in the project area. Most livestock grazing is cattle, although some sheep are also grazed. The Durham Meat Company, a ranch located south of Gillette, raises buffalo (bison) for meat production. The primary use of BLM lands within the project area is grazing.

Recreational land use in the project area includes hunting for mule deer, pronghorn antelope, and elk. Upland game birds and waterfowl also are hunted in limited numbers.

Existing oil and gas fields are scattered throughout the project area. The Marquiss, Lighthouse, and Gillette South CBM projects are located in the southern portion of the project area (**Map 1-1**). The Gillette North CBM assessment area is located just north of Gillette.

Coal mining occurs primarily in the eastern portion of the project area, as shown in **Map 1-2**. There are 16 active coal mine lease areas within and adjacent to the project area. Active coal mines located south

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of Gillette include Caballo (includes Rocky Butte), Belle Ayr, Cordero-Rojo Complex, Coal Creek, Jacobs Ranch, Black Thunder, North Rochelle, North Antelope/Rochelle, and Antelope. North of Gillette, active coal mines include Buckskin, Rawhide, Eagle Butte, Dry Fork, Fort Union/Kfx, and Wyodak.

Gillette is the hub of the existing transportation network in the project area. The major transportation corridors include State Route 59, the principal north-south highway through Campbell County and Gillette, and Interstate 90, the principal east-west highway. Other highways crossing through the project area are U.S. Route 14, and State Routes 50 and 387. Numerous county roads provide local access to public and private lands.

The project area has two major railroads and numerous oil and gas pipelines. The Burlington-Northern/Santa Fe and Union Pacific Railroads pass through Campbell County to the east, west and south of Gillette. Several spur lines connect the railroad with area coal mines for transporting the coal that originates in the PRB. The DM&E Railroad expansion into Wyoming, has received federal approval. The track will terminate at the coal mines located east of State Highway 59 and south of Gillette, in Campbell County, just east of the project area.

There is one public airport in the project area. The Gillette-Campbell County Airport is located three miles northwest of Gillette. The VOR (radio aid used for navigation) is located at the airport.

Implementation of the Wyodak project as approved in the ROD is having a limited affect on land use and transportation. Land ownership is not changing. However, implementation is affecting land use (primarily grazing of livestock and the production of crops). With the level of development approved in the Wyodak Final EIS and ROD, as many as 26,491 acres of the project area have or will be disturbed for the CBM wells and ancillary facilities. Most of this disturbance (59 percent) would be reclaimed within one year of the disturbance's initial occurrence. Thus, the loss of grazing and crops on these 15,763 acres would be short term in nature. Over the long-term, grazing and the production of crops on about 10,788 acres would be lost for the long term.

Implementation of the approved Wyodak action has resulted in an addition of an estimated 480 vehicles operating in the project area for an estimated 756 people employed in CBM field development and production activities. Assuming an equal distribution of vehicles within the approximately 3,600 square-mile project area, the distribution of CBM-related vehicles would be about 3 vehicles per 30 square miles.

RECREATION

Recreational use of the study area by the public is limited, as most of the land is privately owned. Opportunities for dispersed recreation exist on federal and state lands. No developed recreational sites are located in the study area. The nearest developed recreation sites are located in Gillette.

The TBNG provides opportunities for hiking, sight-seeing, hunting and fishing. There are no developed campgrounds in the TBNG, however, camping is allowed.

Dispersed recreational opportunities in the project area include hunting, fishing, sightseeing, all-terrain vehicle (ATV) use, and camping. Hunting is the principal recreation activity on public lands in the study area. Hunting also occurs on some private lands. Pronghorn antelope, mule deer, elk, cottontail rabbit, and sharp-tailed and sage grouse are hunted in the study area (Gillette Convention and Visitors Bureau, 1998). The Marquiss and Lighthouse EAs also identified mourning dove, sage grouse, waterfowl, and cotton-tailed rabbit as resident game species (USDI BLM 1992c and 1995c).

Implementation of the Wyodak project as approved in the ROD is having a limited effect on recreation, primarily because little recreational use is known to occur in the project area. Noise and disturbances associated with the project are probably affecting opportunities for dispersed recreation on public lands, such as hunting, fishing, sightseeing, and camping. Most of this disturbance occurs during the drilling and development phases and, thus, will decrease as the project moves into the long-term production phase. In addition to the these disturbances, the new access roads also are providing recreationists with new points of access to areas that may have had limited access previously.

VISUAL RESOURCES

The landscape of the study area is characterized by open grasslands, low rolling hills, and unobstructed views of many miles. Most of the area is covered with dryland vegetation consisting of grasses and shrubs. Ponderosa pine covers large portions of the north quarter of the study area. Outside the urban areas of Gillette and Wright, the study area is characterized by a rural landscape that has been modified by oil and gas field developments, coal mines and grazing. Grazing activities are evident in most of the study area. Highways, county roads, private roads and utility lines also are evident throughout the study area.

Visual resource management guidelines for BLM lands are to manage public lands for current visual resource management (VRM) classifications and guidelines. The VRM system is the basic tool used by BLM to inventory and manage visual resources on public lands. The VRM classes constitute a spectrum ranging from Class I through Class IV that provides for an increasing level of change within the characteristic landscape. Each VRM class combines an evaluation of visual quality, visual sensitivity of the area, and viewing distances.

Visual resources of BLM-administered lands in the study area are managed in accordance with VRM Classes II, III, IV and V (USDI BLM 1980c), as shown in **Table 3-18** (USDI BLM 1984). The inventory includes state and private lands as well as BLM lands, however the BLM manages visual resources only on BLM lands. The objectives of the BLM VRM classes in the Buffalo Resource Area are defined below.

- Class II - Class II provides for activities that would not be evident in the characteristic landscape. Contrasts are seen, but must not attract attention.

- Class III - The objective is to provide for management activities that may contrast with the basic landscape elements, but remain subordinate to the existing landscape character.

- Class IV - The objective is to provide for management activities that may require major modifications to the existing landscape. The level of change to the landscape can be high and may be visually dominant, but should repeat the form, line, color and texture of the landscape.

- Class V - The classification is applied to areas where the natural character of the landscape has been disturbed to a point where rehabilitation is needed to bring it up to one of the four other classifications.

Table 3-18
Visual Resource Management in the Wyodak Study Area

Visual Class	Percent of Project Area (1,538,000 acres)	Percent of Expanded Project Area (2,317,000 acres)
BLM (includes BLM and private lands)		
VRM Class II	0	0.1
VRM Class III	0.7	0.9
VRM Class IV	95.5	96.4
VRM Class V	0.2	0.2
FS (Thunder Basin National Grassland)		
Modification (VQO)	3.6	2.4
Total Project Area	**100.0**	**100.0**

Most of the study area (96.4 percent) is designated as VRM Class IV. Under Class IV, activities may be dominant, but should repeat the form, line, color, and texture of the landscape. Class II areas consist of the scenic landscape corridor along portions of Interstate 90 and State Route 14 on the west side of the study area. Class III areas are visible primarily from Interstate 90 east of Gillette, and from approximately 2.5 miles of State Route 50 located south of Gillette. The Fortification Creek Wilderness Study Area (west-central part of study area) and Indian Butte cultural resource area (southwest portion of the study area) also are managed as VRM Class III areas. Management activities in VRM Class III areas may be evident, but should remain subordinate to the existing landscape. Existing coal mines along the east boundary of the study area are managed as VRM Class V areas. Class V applies to areas where the natural character has been drastically altered, and the area requires rehabilitation to upgrade it to VRM Classes I through IV. In the study area, coal mines consist of extensive surface mining activities that dominate the landscape within the Class V areas.

The Medicine Bow National Forest has inventoried Visual Quality Objectives (VQOs) for the portion of the federally owned surface within the TBNG and the study area. The FS management objectives for visual resources within the TBNG are to provide for characteristic landscapes that satisfy the adopted VQO. The federally owned TBNG lands in the study area are managed in accordance with the VQO of modification (USDA FS 1992).

FS management direction for visual resource management requires that facility and structure design, color of materials, location and orientation meet the adopted VQOs for the management area affected by the project. Monitoring is required for oil and gas exploration and development on leased grasslands upon completion of the project in order to establish compliance with the adopted VQOs. Visual resource management objectives for the modification and maximum modification VQOs should be met within three full growing seasons after completion of a project.

Implementation of the Wyodak project as approved in the ROD is affecting the visual character of the project area. However, mitigation measures associated with the project are minimizing these effects. The new wellheads, production pod facilities, improved roads, and compression facilities are visible additions to the landscape. However, the addition of these facilities is not changing the overall visual character of the existing rural landscape because other oil and gas activities and coal mining have modified the landscape considerably.

NOISE

The study area has land uses that vary from sparsely populated rural regions to more densely populated urbanized areas, such as towns. Background noise measurements have not been conducted in the study area. Existing or background noise levels in sparsely populated areas are likely to be similar to the analysis of background noise levels completed for the Enron Burley Area (USDI BLM 1994b). Background noise levels for the EPA category "farm in valley" are: daytime, 29 dBA; evening, 39 dBA; and nighttime, 32 dBA. Local conditions, such as topography and frequent high winds, can alter background noise conditions. The unit of measure used to represent sound pressure levels (decibels) using the A-weighted scale is (dBA). It is a measure designed to simulate human hearing by placing less emphasis on lower frequency noise because the human ear does not perceive sounds at low frequency in the same manner as sounds at higher frequencies.

Implementation of the Wyodak project is resulting in short-term and long-term increases in local noise. Noise originating from construction equipment (e.g., drilling rigs and construction vehicles) is apparent locally over the short term (i.e., 30 to 60 days) where drilling and construction activities are occurring. However, the drilling and construction sites are sufficiently widespread that the elevated levels of noise generated from each site is not overlapping in time or space with noise from other sites.

Long-term noise is associated with the new compressor sites. Operation of these compressors is affecting the levels of noise within about 600 feet of each site. However, because the sites are being located more than 600 feet from sensitive receptors (e.g., residences, schools, medical facilities, and recreational facilities), no substantive effects from the noise are expected to occur.

SOCIOECONOMICS

The study area is located within Campbell County and small portions of Converse, Johnson, and Sheridan counties. There are two incorporated municipalities affected by the proposed project; Gillette and Wright. Gillette is the county seat and the largest incorporated city in Campbell County. Wright is located in southern Campbell County. There are no incorporated communities in Converse, Johnson, or Sheridan Counties that are located within the study area.

The 1997 population of Campbell County is estimated at 32,087. The populations of Gillette and Wright are estimated at 19,289 and 1,347, respectively. In 1997, the population of Converse County was estimated to be 12,295. **Table 3-19** summarizes population growth in Campbell, Converse, Johnson, and Sheridan Counties between 1980 and 1997.

Table 3-19
Population in Campbell, Converse, Johnson, and Sheridan Counties

Year	1980	1990	1995	1996	1997	2000 (projected)
Campbell County	24,367	29,370	31,456	31,951	32,087	32,970
Gillette	14,545	17,545	21,023	21,585	19,289	19,744
Wright	na	1,117	1,357	1,385	1,347	1,378
Converse County	14,069	11,128	11,929	12,112	12,295	12,350
Johnson County	6,700	6,145	6,627	6,717	6,796	6,920
Sheridan County	25,048	23,562	24,997	25,203	25,199	25,900

Source: Wyoming Division of Economic Analysis 1997, CCEDC 1997

Mineral production of coal, oil, and gas is the dominant economic activity in Campbell County. It is also an important economic sector in Converse County. Wyoming is the top coal producing state in the United States. More than 90 percent of the coal produced in Wyoming comes from Campbell County (Campbell County Chamber of Commerce 1998). Campbell County also produces approximately 25 percent of the oil produced in Wyoming each year. **Table 3-20** shows the state assessed mineral production valuations for the affected counties and the State of Wyoming for its 1997 fiscal year, which are based on 1996 production.

Agriculture, consisting of livestock production and dryland farming, also is an important sector of the economic base within the affected counties. According to the Campbell County Economic Development Corporation (CCEDC 1997), the livestock population in the county consists primarily of cattle and sheep. Most cropland in Campbell County produces wheat, barley, oats and hay for feed. Agriculture in Converse, Johnson, and Sheridan Counties consists of ranching, row crops such as wheat, barley and oats, and irrigated forage crops.

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Table 3-20
Taxable Valuation of Mineral Production for Fiscal Year 1997, Based on 1996 Production
Campbell, Converse, Johnson, and Sheridan Counties

	Mineral Valuation ($)							
	Coal	Oil	Natural Gas	Sand & Gravel	Uranium	Other Minerals[1]	All Minerals[2]	Total Assessed Valuation[2]
Wyoming Valuation	1.22 billion	1.26 billion	1.08 billion	7.87 million	15.4 million	293 million	3.88 billion	7.15 billion
Campbell County Valuation	933 million	322 million	29.1 million	1.98 million	6.90 million	0	1.29 billion	1.59 billion
Percent of State's Valuation	76.5	25.6	2.7	25.2	44.8	0	33.2	22.2
Converse County Valuation	49.5 million	81.8 million	32.2 million	0.47 million	8.32 million	0.26 million	172.6 million	0.28 billion
Percent of State's Valuation	4.1	6.5	3.0	6.0	54.0	0.09	4.4	3.9
Johnson County Valuation	0	28.0 million	1.1 million	0.24 million	0.18 million	1.28 million	30.8 million	0.08 billion
Percent of State's Valuation	0	2.2	0.1	3.0	1.2	0.4	0.8	1.1
Sheridan County Valuation	0.18 million	1.08 million	0	0.21 million	0	0	1.5 million	0.12 billion
Percent of State's Valuation	0.01	0.09	0	2.7	0	0	0.04	1.7

Source: Wyoming Department of Revenue (WDR) records, for the State of Wyoming; fiscal year 1997 was July 1, 1996 through June 30, 1997 (WDR 1999a).

[1] Includes bentonite produced in Johnson County and leonardite produced in Converse County.

[2] Mineral production valuation is 54.2 percent of Wyoming's 1997 statewide valuation (WDR 1999b).

Wyoming Department of Employment (WDOE) records describe the employment sectors in the affected counties. The largest employment sectors in Campbell County are mining, retail trade, government and services (WDOE 1998a). In 1996, the average total employment for Campbell County was 15,988. The mining sector accounted for 4,087 workers, or 25.6 percent of total employment in the county. Retail trade accounted for 17.5 percent of the total employment. State, local and federal government employed 18.9 of the total workforce. Service industries accounted for approximately 14.8 percent of employment. Agriculture, which is part of the economic base of the county, accounted for 0.5 percent of employment. The 1996 annual average unemployment rate was 4.7 percent. The average unemployment rate for the state was 5.0 percent in 1996 (WDOE 1998b).

In Converse County, the largest employment sectors are government, retail, mining and services (WDOE 1998a). In 1996, the average total employment for Converse County was 4,124. Government accounted for 27.7 percent of total employment. The retail sector accounted for 19.9 percent. Mining employed 15.9 percent of the total workforce. Service industries accounted for about 12.8 percent of employment. Agriculture, which consists primarily of ranching, accounted for 1.7 percent of employment. The 1996 annual average unemployment rate was 5.4 percent.

The largest employment sectors in Johnson and Sheridan Counties are government, retail, and services (WDOE 1998a) and is documented in records maintained by the Bureau of Economic Analysis (BEA) within the U.S. Department of Commerce. In 1996, the total labor force in Johnson County was 3,747 workers. In Sheridan County the labor force was 13,608 workers. The 1996 annual average unemployment rate was 3.8 percent in Johnson County and 4.8 percent in Sheridan County.

Per capita income indicates the economic well-being of the residents of an area and is documented in records maintained by the Bureau of Economic Analysis (BEA) within the U.S. Department of Commerce (USDC). The per capita income in Campbell County averaged $21,908 in 1996, which ranked sixth in the State of Wyoming, and was 101 percent of the average 1996 per capita income of $21,587 for the State of Wyoming (USDC BEA 1998). Total personal income for the county in 1996 was approximately $700 million, which accounted for 6.8 percent of the 1996 total personal income for the State of Wyoming, approximately $10.4 billion (USDC BEA 1998).

Total 1996 county personal income earned from the mining sector, including oil and gas extraction, was nearly $250 million, representing 42.2 percent of the total personal 1996 income for the county (USDC BEA 1998).

The per capita income in Converse County averaged $18,094 in 1996, which ranked 18th in the State of Wyoming, and was 84 percent of the state average. Total personal income for the county in 1996 was approximately $219 million, which accounted for 2.1 percent of the 1996 state total. Total 1996 county personal income earned from the mining sector, including oil and gas extraction, was approximately $56 million, representing 25.6 percent of the total personal 1996 income for the county (USDC BEA 1998). Earnings from the mining sector increased 15.8 percent from 1995 earnings in Converse County.

The per capita income in Johnson County averaged $20,571 in 1996, which ranked 12th in the State of Wyoming, and was 95 percent of the state average. Total personal income for the county in 1996 was approximately $138 million, which accounted for 1.3 percent of the 1996 state total. The mining sector accounted for 11.3 percent of earnings in 1996, and was one of the fastest growing industries in the county (USDC BEA 1998).

The per capita income in Sheridan County averaged $23,332 in 1996, which ranked 3rd in the State of Wyoming, and was 108 percent of the state average. Total personal income for the county in 1996 was approximately $588 million, which accounted for 5.7 percent of the 1996 state total. The mining industry was not a significant sector of the economy in 1996.

The majority of available housing units in the study area are located in the communities of Gillette and Wright. In 1996, there were approximately 7,474 housing units in Gillette and 492 housing units in Wright (as of December 1995). In Gillette, the average cost of a new three-bedroom home in 1996 was $109,900. The average 1996 cost for a new home in Wright was $88,000. Approximately 30 percent of the existing housing stock in Gillette were rental units. The average rent for an apartment was $350 in 1996. As of October 1994, the overall vacancy rate in Gillette for all types of housing was approximately 2 percent (Gillette Department of Community Development 1997).

Government and community services available in the Counties include county government, law enforcement, fire protection, roads and bridges, infrastructure and maintenance, solid waste disposal, medical and emergency services, public school systems, a community college, and county libraries.

The ongoing CBM field development (Wyodak approved action) is most probably affecting the project area's socioeconomic environment. However, until results of the standard measures that the federal, state, and local governments compile annually are released to the public, the quantitative evaluations of the effects are not available. With the current addition of almost about 756 employees for the project and several hundred indirect support industry jobs, employment levels and opportunities for CBM-related positions within the project area have likely increased and are increasing. These jobs also are generating millions of dollars in additional wages, salaries, and taxes. In addition, the producing wells are generating millions of dollars in federal royalties, fee royalties, and taxes (severance, advalorem, sales, and use). Demand for housing and public services also is probably increasing.

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CHAPTER 4
ENVIRONMENTAL CONSEQUENCES

INTRODUCTION

This chapter of the EA provides an analysis of the impacts (environmental consequences) that would result from implementation of the PA. Certain measures that would avoid or reduce impacts have been included as part of the PA as discussed in Chapter 2. The environmental impact analysis documented in this chapter considered these measures in the assessment of impacts.

The impact analyses in this chapter also considered the level of impact from implementation of the PA in comparison to levels of impact assessed in the Wyodak EIS. Those impacts addressed in the Wyodak EIS and approved in the Wyodak ROD for the approved action (Alternative 1) have been considered in this EA as threshold criteria for the determination of significant impacts. The analysis has shown that potential impacts to resources are either less than those impacts assessed in the Wyodak EIS or are not significant. Based on the issues of concern for this PA, both the amount of disturbance as it affects surface-related resources and the amount of groundwater to be produced and discharged on the surface were potentially significant issues. The basis for analysis of both of these issues areas are introduced below and discussed in more detail in the resource-specific sections that comprise the remainder of this chapter.

The Wyodak EIS' analysis determined the alternative selected in the ROD would disturb a total of 26,551 acres. Of this total, 103 acres were associated with compressor stations. Thus, 26,448 acres were expected to be disturbed for pads, roads, pipelines, and central gathering and metering facilities.

Since the Wyodak ROD was published, the BLM has monitored disturbance associated with the new wells and ancillary facilities. Results of this monitoring suggest the actual areal extent of the 1,063 federal wells and associated facilities is 1,470 acres. This disturbance equates to an actual rate of about 1.38 acres of disturbance per well.

Assuming this actual rate of disturbance remains constant through implementation of the PA, the cumulative drilling of 12,501 wells (includes Wyodak EIS wells, the PA's 2,500 wells, and projected state and fee wells) would affect 17,251 acres. This figure is well below the total areal extent of disturbance projected in the Wyodak EIS (26,448 acres) for these facilities. Thus, disturbance associated with the PA in addition to those associated with the 1999 Wyodak project do not exceed the level of effect disclosed in the Wyodak EIS and ROD.

Based on the BLM's and WOGCC's current projection for increased numbers of wells and their compilation of water production data for existing wells, total water production for 1,425 new producing protective federal wells would be approximately 98,172 acre feet over the 15-month period or about 82,900 acre feet for the 12-month period ending February 28, 2002. This estimate is based on the WOGCC's recent compilation of federal and state water production data for existing CBM wells (WOGCC 2000). For the 6-month period of January 2000 through June 2000, the discharge rate from

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producing wells averaged 11.1 gallons per minute (gpm). Applying this same production rate of 11.1 gpm per well over the same 15-month period to 4,093 existing producing wells (as of November 30, 2000), to a projected 1,611 new state and fee producing wells, and to the proposed production from the 1,425 federal protective wells, water production would total approximately 127,497 acre feet (as of February 28, 2002) or about 107,660 acre-feet per year based on the previous 12 months of projected production.

The maximum rate of water production under the approved action for the Wyodak EIS was estimated to be 101.8 mgd or 114,030 acre-feet per year (Wyodak FEIS, p. 4-63). The comparison between the projected volumes of water to be produced daily and annually under the PA in combination with existing well water production and the volumes for the approved action in Wyodak EIS indicates CBM-generated flows for the PA would be less than those volumes estimated in the Wyodak EIS.

GEOLOGY & MINERALS

Impacts to geology and mineral resources from implementation of the PA, 2,500 (1,425 producing) federal protective CBM wells and associated facilities, in the same project area would be similar in type, extent, and duration to those effects described in the Wyodak EIS for Alternative 1 (approved action)(Wyodak ROD). The direct and indirect effects of the PA on geology and mineral resources would affect the same region, localities, and interests, as described in the Wyodak EIS.

Under the PA, natural gas (methane) would be produced from 1,425 federal protective CBM wells drilled and completed into underlying coal seams in the PRB. The methane would be produced from federal wells before the resource is drained from federal leases by nearby non-federal wells. The drainage loss of CBM resources has been estimated by the BLM to be 69,062 mcfg/well over a two year period that the drilling of federal protective wells would be delayed, if the PA is not implemented (USDI BLM 2000). The development of federal protective wells and production of CBM under the PA would recover this methane and yield millions of dollars in royalties for the U.S. Treasury and the State of Wyoming. These royalties would be unrecoverable unless the PA is implemented in a timely manner. The BLM has estimated the value of the CBM resources that are presently being drained from federal leases without compensation, and has estimated that federal royalty loss could range from about $30 million (continuing, uninterrupted APD approvals) to as much as $85 million should federal APD approvals be interrupted for a two year period.

Past conflicts between CBM development and expanding surface coal mining operations indicate potential conflicts may arise under the PA; however, an outcome of the Wyodak EIS process was that the BLM will either stipulate, in new CBM leases or sponsor cooperation between the CBM and mining, for mutual agreements for affected areas, such as ensuring that CBM development occurs prior to mining or is precluded from some mine areas. CBM development occurring near surface coal mines likely would increase surface flows in the vicinity of coal operations and decrease the rate of groundwater withdrawals that currently accompany ongoing coal mining operations. Changed conditions could affect the design or permitting of coal mining operations and the mining schedule for specific areas. Coal mining prior to CBM development would result in valuable CBM resources and royalties not being recovered from the mined area.

Methane migration or seepage could occur within the PRB as CBM development occurs under the PA. Conditions for methane release would depend on site-specific geologic conditions and/or the specific well development conditions that remain after construction. Methane could emerge from water wells near CBM production areas, affecting stock and residential water wells. The escape of methane also can result from inadequate well control procedures or faulty well casing or plugging. Methane would be controlled through BLM-mandated APD conditions of approval that address well control, casing, ventilation, and plugging procedures appropriate to site-specific CBM development plans.

CBM development in the PRB, including development anticipated under the PA, is occurring under confined conditions in the coal aquifer, which are not associated with spontaneous fires. The removal of water from the coal seam during CBM development is not likely to leave the coal seam in a condition where oxygen would replace water in the coal seam and result in spontaneous combustion. Underground fires are not expected to occur under the PA.

The Ft. Union Formation, which is being partially dewatered by CBM development, is a consolidated rock unit, unlike unconsolidated alluvial aquifers that have collapsed in other areas due to dewatering, causing ground subsidence. Neither aquifer collapse nor ground subsidence are expected to occur as the Ft. Union Formation is partially dewatered under the PA.

Withdrawal of CBM and water from the stratigraphically lower Ft. Union Formation would not be likely to affect the potential recovery of uranium resources from the overlying Wasatch Formation. However, depending upon the proximity of operations and local geologic conditions, CBM development could adversely impact the in-situ leach extraction process used in uranium mining operations in the PRB. Conflicts between CBM development and uranium mining will be analyzed site-specifically at the APD/POD level of analysis, as plans of development are reviewed by the BLM.

WATER RESOURCES

Impacts to water resources from implementation of the PA, 2,500 (1,425 producing) federal protective CBM wells and associated facilities, would be similar in type, extent, and duration to those effects described in the Wyodak EIS for the approved project. The direct and indirect effects of the PA on water resources, in context, affect the same region, localities, and interests, as described in the Wyodak EIS. The intensity of CBM development and its impacts under the PA would be similar to the intensity of CBM development and its impacts under the approved project for the Wyodak EIS for a 15-month implementation period for the PA. Direct impacts would result from the withdrawal of groundwater from underground coal aquifers and the subsequent discharge of this produced water upon the land surface in established drainageways or water storage facilities. The quantity and quality of surface water flows would be affected by the quantity and water chemistry of the produced water. Indirect impacts associated with land or water use, and methane migration or seepage could result from the anticipated drawdown of the static water levels in water wells situated near CBM development areas. The increased volumes of surface water available during the life of the project in areas that previously were dry could indirectly affect landowners, coal mines, ecosystems, wildlife and fisheries resources, wetlands, vegetation resources, land or water use, or local social and economic conditions (socioeconomics).

Under the PA, potential impacts to existing water uses and ecosystems at specific locations are expected to be similar to the impacts described in the Wyodak EIS. Many of the projected impacts can be attributed to the anticipated increase in surface flows from the discharge of CBM produced water within the project area. Accelerated erosion and degradation of stream channels that are not stable, armored, or large enough to accommodate anticipated flows can be expected unless discharge out-falls are well designed. There is the potential for increased frequency and magnitude of localized flooding where channels or basin capacity is insufficient to handle the increased flows. Since CBM generated flows occur year-round, average daily flows from discharge points into drainages would be increased, producing perennial flows in previously ephemeral draws and drainages for some distance downstream. Subject to ownership decision and water quality standards, the increased daily flows from discharged produced water would be available for beneficial uses such as livestock watering, wildlife use, fisheries development, and crop irrigation unless the produced water quality falls below standards of suitability that would allow continued use. Increased flows may facilitate the need for modifying discharge facilities to minimize sedimentation downstream from produced water discharge locations. Additional surface water monitoring stations downstream of the project area may be necessary to monitor water quality of the produced water discharges with respect to applicable water quality standards of the receiving stream.

Surface Water

Water volumes produced from CBM wells within the project area are expected to increase from 65.4 million gallons per day (mgd), for an estimated 4,093 CBM wells producing as of November 30, 2000, to an estimated maximum water production of 88.2 mgd with the addition of the PA's 1,425 federal producing wells within the 15-month implementation period. The annual rate of water production as of the end of the 15-month period (February 28, 2002) would be approximately 82,900 acre-feet per year based on the previous 12 months of projected production. The maximum rate of water production under the approved action for the Wyodak EIS was estimated to be 101.8 mgd or 114,030 acre-feet per year (Wyodak FEIS, p. 4-63). The comparison between the projected volumes of water to be produced daily and annually under the PA in combination with existing well water production and the volumes for the approved action in Wyodak EIS indicates CBM-generated flows for the PA would be less than those volumes estimated in the Wyodak EIS.

In addition to 1) reduced flows in drainages based on a revised estimate of 11.1 gpm per well versus 12 gpm as estimated in the Wyodak EIS analysis and 2) reduced number of producing wells of 5,518 for the PA (1,425 federal wells) (February 28, 2002) and existing 4,093 wells versus, 5,890 wells for the approved action (Wyodak EIS), stream flows including discharged produced water and associated impacts may be further mitigated by downstream infiltration and evapotranspiration. Field observations of streamflows in the Belle Fourche drainage basin during 1997-1999 indicate that little or none of the water discharge as a result of CBM operations currently is making it to the stream gage locations (Meyer 2000).

Meyer estimates that during periods of little or no precipitation, losses of CBM generated flows due to evaporation, transpiration and infiltration/alluvial recharge from streams and impoundments may be greater than 90 percent. Similar trends were noted by Meyer in the Little Powder River drainage. Meyer concludes that "water production volumes are not as great as estimated, (in the Wyodak EIS) and streamflow conveyance losses have been significantly greater than predicted."

Under the PA, the water quality of the CBM produced water is expected to be similar to that of existing discharges within the project area. Produced water contains an average (mean value) of 840 mg/l TDS (Rice et al. 2000). CBM generated water at these TDS levels would likely comprise one-half of the total surface water volume produced annually in the project area. Analysis of the available data suggests that TDS levels vary geographically, increasing from south to north and east to west. Regional flow is towards the northwest, therefore it is expected that the water would become more mineralized as the distance from the recharge areas increases.

Produced water would have a greater sodium bicarbonate character than naturally occurring surface waters. Because of the dominance of the sodium ion in proportion to the calcium and magnesium ions, SAR values may limit the use of the CBM produced water for irrigation purposes. SAR values greater than 10 to 15 pose a potential hazard to crops that are not tolerant of reduced soil moisture and oxygen availability. Of the 47 samples taken from the Wyodak-Anderson coal, 16 (34 percent) have SAR values equal or greater to 10. In conjunction with high SAR values, produced water contains an average (mean value) of 1300 ms/cm specific conductance, which is used as a measurement of salinity (Rice et al, 2000). Water with a salinity hazard greater than 750 ms/cm EC may be unsuitable for use on soils with restricted drainage (Richards 1969). Special management for salinity and sodicity (SAR) control may be required, or irrigation use may need to be restricted to salt-tolerant crops. The CBM produced water is not expected to have any impact on stock watering. Salinity levels as high as 3,500 mg/l TDS are still considered suitable for consumption by livestock.

The concentrations of iron in the 47 samples taken from the Wyodak-Anderson coal exceed the human health standard of 0.3 mg/l in 68 percent of the samples. Manganese concentrations exceed the human health standard of 0.05 mg/l in 17 percent of the 47 samples. Iron and manganese limitations are based on aesthetics rather than toxicity; these metals can tint water and stain outlet works, but typically would not cause health effects. Barium concentrations among the 47 samples range from a high of 1.6 mg/l to a low of 0.14 mg/l (mean of 0.62 mg/l). CBM produced water with barium concentrations within this range would not exceed the human health standard of 2.0 mg/l proposed by the WDEQ following a recent antidegradation review. Based on available water quality data, it is anticipated that less than 10 percent of CBM discharges would require preliminary treatment to reduce barium concentrations prior to discharge. CBM discharges are analyzed for the presence of radioactive radium-226, and total petroleum hydrocarbons, but a review of existing data indicates that the limitations of 60 pCi/l of radium-226, and 10 mg/l of TPH have not been exceeded in previous discharges (WDEQ 1998).

The total estimated area that may be affected by runoff and sedimentation due to disturbance caused by drilling or construction activities associated with CBM development under the PA is 3,450 acres. Short-

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term disturbance, continuing up to three years, would occur over an estimated 1,553 acres. Long-term disturbance continuing during the life of the project would occur over an estimated 1,897 acres. Timely erosion control measures, recontouring, and revegetation would minimize sedimentation caused by runoff in disturbed areas.

Groundwater

Well production of groundwater from the coal aquifer as part of the PA would typically reduce the hydraulic pressure head and produce methane, and also lower the water level in nearby wells completed in the coal seam. As the annual rate of water production for the PA in combination with existing wells is less than the maximum annual rate projected and analyzed in a calibrated groundwater model of the region, drawdown of water levels in the project area's underlying coal aquifer from PA implementation is anticipated to be less than the drawdown that was projected for the approved action in the Wyodak EIS. Water production under the PA in combination with existing wells would occur at an annual rate of 82,900 acre-feet per year. This rate is less than the maximum projected annual rate of 114,030 acre-feet per year for the approved action analyzed in the Wyodak EIS.

Thus, the areal extent and magnitude of expected aquifer drawdowns projected for the PA in combination with existing wells would be less than those drawdowns that were projected for the approved action analyzed in the Wyodak EIS. The federal protective wells that comprise the PA likely would be distributed in a similar manner to the proposed development scenario that was analyzed in groundwater modeling completed for the Wyodak EIS. Development occurring under the PA would not be more closely spaced than was analyzed in the Wyodak EIS. Additionally, the federal protective wells drilled under the PA are expected to be situated in areas where CBM production already is occurring and water production already is decreasing over time.

After CBM development (and water removal) ends, within three to four years water levels in the coal aquifers are expected to partially recover to within 20 to 30 feet of pre-operational conditions. Complete water level recovery will be a long-term process, likely requiring hundreds of years for the removed groundwater to be replaced through the infiltration of precipitation.

Recharge to shallow aquifers would be expected to continue over the life of the project through infiltration of precipitation and produced water that is discharged to the land surface. None to negligible impacts to existing groundwater quality are anticipated to occur from implementation of the PA.

AIR QUALITY

Implementation of the PA would result in minimal effects on the air quality of the project area's and region's airsheds. Given the absence of any new proposed gas-fired compressors, the PA would not contribute any air pollution from emissions released from internal combustion engines. However, the PA would likely contribute to fugitive dust emissions, in the form of PM_{10}, from road dust generated by vehicular traffic.

Based on the formula for estimating fugitive dust emissions from vehicles on unpaved roads presented in the Wyodak EIS, the projected amount of dust that would be generated by the 5,000-well approved project analyzed in the Wyodak EIS, and the PA's 2,500 wells, dust levels for the PA would likely be about half of levels estimated for the approved project (Wyodak ROD). Since the calculated fugitive dust emission levels for the approved Wyodak project were determined to be negligible, fugitive dust emissions would be negligible for the PA. Any dust generated by vehicles at a given location would be localized and short-term.

NO_x emissions would also result from project vehicle exhausts. Calculation of the emissions using an EPA methodology and a NO_x emissions factor of 1.5 gm NO_x per vehicle mile (USEPA 1991) resulted an estimate of 29.7 lbs of NO_x ((1.5 gm/mile x 9,000 vehicle miles)/454 gm/lb) would be produced per day, or about 5.4 tons per year. Distributing these project emissions over the 2,317,000-acre project area would result in a vehicle emissions factor and minimal yield of 0.004 NO_x pound per acre per year.

SOILS

Potential impacts to soil resources from implementation of the PA, 2,500 federal protective CBM wells and associated facilities, would be similar in type, extent, and duration to those impacts described in the Wyodak EIS. Direct impacts would likely include:

- Removal of protective vegetative cover and loss of soil/vegetative productivity;
- Increased exposure of surface soil materials to accelerated erosion from blading and/or compaction of soil materials; and
- Loss of soil profile development, soil structure, and nutrients from soil excavation and mixing of soil horizons.

Loss of cover and productivity would occur for an estimated 3,450 acres due to disturbance from well drilling and completion and construction of associated facilities. Of the projected total of 3,450 acres of disturbance, short-term disturbance of up to 3 years would total an estimated 1,553 acres. Long-term disturbance for the 7 to 10 year life of project would total an estimated 1,897 acres. The application of the reclamation measures outlined in the BLM's and FS' Standard Conditions of Approval for APDs (**Appendix B**) to areas of short-term disturbance (pipeline construction) would return the soil to conditions sufficient to support vegetative cover and productivity comparable to pre-disturbance conditions. The mitigative measures presented in the Standard Conditions of Approval for APDs would also apply to those areas of long-term disturbance requiring reclamation. In addition, soil loss would be minimized by limiting the following: the removal of vegetation, the leveling of work areas, and locating wells on steeper slopes and erosive soils.

Indirect impacts to soils could result should produced water discharges inundate and saturate or wet soils for prolonged periods. Prolonged periods of wetting/saturation would alter the ability of the soil to support existing vegetation and may facilitate invasion of noxious weeds. Inundation or irrigation with produced water with high salinity or sodicity content may also diminish the long-term productivity of soils. The irrigation hazard posed CBM produced water, if used directly for irrigation, could be high based on elevated salinity levels and SAR values reported for a number of wells located in the Wyodak project area (Rice et. al. 2000). The development of saline/sodic and/or wet soil conditions would be minimized by locating most discharge points in open watersheds and by not irrigating with poor quality produced water.

The estimated total disturbance for the PA (3,450 acres) represents 0.15 percent of the 2,317,000-acre Wyodak project area. The 3,450 acres of new soil disturbance represents about 13 percent of the 26,491 acres of disturbance analyzed under the selected alternative in the Wyodak EIS.

VEGETATION RESOURCES

Impacts to vegetation resources from implementation of the PA, 2,500 federal protective CBM wells and associated facilities, would be similar in type, extent, and duration to those impacts described in the Wyodak EIS. Direct impacts would result from the clearing or damage of vegetation during drilling and construction of facilities that would affect losses of vegetative cover and productivity and changes in community abundance, species composition, density, and diversity. A potential indirect impact may result where existing vegetation is altered by inundation from discharged produced water and the potential increase in soil salinity resulting from evapotranspiration of these waters. Noxious weeds may also become established following disturbance.

Most of the CBM drilling and completion operations and associated facilities construction would occur over natural terrain. Associated with the installation and operation of these wells and associated facilities are short-term and long-term disturbances. Short-term impacts to vegetation would be the clearing, excavation, and/or damage of vegetation within drill sites and within construction corridors of gas gathering lines, gas trunklines, water discharge lines, and two-track roads to unproductive wells. These impacts to vegetation would typically be reclaimed soon after construction, during the following spring or fall season. Long-term impacts to vegetation are associated with two-track access roads to productive wells, wellhead facilities, compressor stations, pod facilities, improved roads to production pods, and booster compressors. Effects from these impacts will be reclaimed following the life of the project.

The anticipated acreage of vegetative disturbance from the PA's drilling of the 2,500 wells, construction of facilities, and field operations is 3,450 acres, based on the 1.38 acres per well disturbance factor defined in Chapter 2. Of the projected total of 3,450 acres of disturbance, short-term disturbance and loss of vegetative productivity of up to 3 years would be estimated at 1,553 acres. Long-term disturbance of vegetation would total 1,897 acres. The estimated total disturbance for the PA (3,450 acres) represents 0.15 percent of the total acreage (2,317,000 acres) included in the Wyodak project area. The 3,450 acres of new disturbance represents approximately 13 percent of the 26,491 acres of disturbance analyzed under the selected alternative in the Wyodak EIS.

WETLANDS

Anticipated impacts to wetlands resulting from implementation of the PA would be similar to those effects described in the Wyodak EIS. The BLM, and other federal agencies, are mandated to minimize the destruction, loss, and degradation of wetland habitats. The BLM operating procedures strictly control or, if absolutely necessary, prohibit surface disturbance within 500 feet of surface water or riparian areas, unless an acceptable plan for mitigation is agreed upon through site-specific analysis. In keeping with BLM standard procedures, implementation of the PA would likely not result in wetlands being filled or dredged, and therefore, directly impacted.

Indirect impacts resulting from the discharge of produced water are expected to result from the expansion of existing wetlands, the development of new ones, possible invasion by noxious weeds, and salinization of soils as described in the Wyodak EIS. Mitigative wetland "banking", COE conditions and requirements(**Appendix A**), and other mitigation measures required by the Wyodak ROD including Standard "Conditions of Approval" for APDs (**Appendices B and C**) would be implemented as part of the PA to reduce impacts to acceptable levels consistent with the Wyodak ROD.

WILDLIFE AND FISHERIES

Impacts to wildlife and fisheries resources from implementation of the PA, 2,500 federal protective CBM wells and associated facilities, would be similar in type, extent, and duration to those impacts described in the Wyodak EIS. Direct loss of terrestrial habitats within the project area may reduce or eliminate forage, protective cover, breeding sites, nesting cover, and thermal cover. Most CBM operations would occur over natural terrain. Terrestrial wildlife, dependent on these areas affected by CBM well drilling, facilities construction, and field operations, would likely be displaced, which would result in the effects described in the Wyodak EIS analysis. Duration of displacement would be short- and long-term. Short-term impacts to terrestrial species would include: 1) the direct effects of clearing, excavation, and/or damage of habitat within drill sites and within construction corridors of gas gathering lines, gas trunklines, water discharge lines, and two-track roads to unproductive wells; and 2) the indirect effects of displacement of individuals away from zones of human and vehicular/construction activity. These impacts would be reduced upon cessation of the drilling and construction period for wells and facilities, respectively. Long-term direct impacts to terrestrial wildlife species would be associated with the direct loss of habitats within the boundaries of two-track access roads to productive wells, wellhead facilities, compressor stations, pod facilities, improved roads to productionpods, and booster compressors. Long-term indirect impacts would include the reduced, but continued, displacement of some species and individuals away from facilities periodically used or accessed by vehicles. Indirect impacts could result from increased poaching due to new access roads.

The discharge of produced water under the PA would likely increase the amount of aquatic habitats within the Wyodak project area. Ponded waters or waters held in reservoirs would likely expand should the waters reach such impoundments before losses of flow by infiltration and/or evapotranspiration occur. As was determined in the Wyodak EIS, water quality of streams is not likely to be degraded by increased sediment loads. Implementation of site-specific conditions of approval for APDs would minimize stream and impoundment sedimentation from discharged produced waters.

Wildlife groups likely to be affected by implementation of the PA are the same as those described in detail in the Wyodak EIS. The wildlife groups, specific species of concern, and proposed mitigation measures to be affected by the PA are outlined below.

Big Game

- Antelope winter, winter/yearlong, and yearlong; mule deer winter/yearlong and yearlong; white-tailed deer winter and yearlong; and elk habitat may be impacted.

- Animals may become habituated to CBM operations; implementation of existing mitigative conditions of approval and lease stipulations would minimize impacts.

Upland Birds

- Several grouse leks have been identified in the Wyodak project area.
- Applicable mitigation measures include:
  - No permanent occupancy within ¼ mile of lek.
  - No surface disturbance within 2 miles during breeding season.
  - (March 1 through June 15).

Raptors

- Potential for highly localized shift in prey availability – not expected to be detrimental; potential disturbance may occur during breeding season.
- Implementation of standard conditions of approval including limiting access during breeding seasons and appropriate power line construction design would minimize impacts.

Waterfowl, Shorebirds, and Other Species

- Discharge of production water may create more favorable habitats.
- Impacts to this group not expected to be detrimental.

Fish

- Produced water may increase reservoir surface area and create new water bodies suitable to receive stocked game fish species.
- Impacts to this group not expected to be detrimental.

The anticipated acreage of habitat disturbance from the PA's drilling of the 2,500 wells, construction of facilities, and field operations is 3,450 acres, based on the 1.38-acres per well disturbance factor defined in Chapter 2. Of the projected total of 3,450 acres of disturbance, short-term disturbance and direct loss of habitats of up to 3 years would be 1,553 acres. Long-term, direct disturbance of wildlife habitats would total 1,897 acres. The estimated total disturbance for the PA (3,450 acres) represents 0.15 percent of the total acreage (2,317,000 acres) included in the Wyodak project area. The 3,450 acres of new disturbance represents approximately 13 percent of the 26,491 acres of disturbance analyzed under the selected alternative in the Wyodak EIS. The nature of the proposed action would be widely dispersed throughout the project area and would subsequently reduce the concentration of operations and workforce disturbances.

SPECIAL STATUS SPECIES

The PA would potentially impact several special-status species that were evaluated in the Wyodak EIS analysis. Potential impacts to these species and potential mitigative measures are outlined below.

Bald Eagle

- Three documented roosting sites exist within the project area.
- Temporal and spatial restrictions will be applied in these areas.
- No detrimental impacts are expected to this species.

Black-footed Ferret

- Suitable habitat exists in the project area.
- No known occurrences of this species exist.
- Surveys will be conducted if suitable habitat and prey base is identified.
- No detrimental impacts are expected to this species.

Black-tailed Prairie Dog

- The black-tailed prairie dog is under review by the USFWS for possible designation as a federally threatened species.
- BLM's operating standards requires avoiding disturbance of prairie dog colonies.

Swift Fox

- Suitable habitat exists within the project area.
- Definitive proof of occurrence for this species is not available.
- If present, potential impacts and their significance will be highly dependent upon the spatial relationship between the disturbance and the den sites.
- Appropriate mitigation measures will applied, if necessary.

Mountain Plover

- Suitable habitat exists throughout the project area.
- Impacts are a potential during the breeding season (mid-March through late-June).
- Pre-construction surveys and/or timing restrictions on ground activities will be applied when necessary.
- Appropriate revegetation will be applied to help ensure suitable habitat is created following disturbance.

Sturgeon Chub

- No suitable habitat for this species occurs within the project area.
- No detrimental impacts are expected to this species.

Ute-ladies' Tresses Orchid

- Suitable habitat for this species occurs in the project area.
- Restricted to riparian habitats.
- Prior to ground activities in or adjacent to potential habitat, pre-construction surveys will be conducted.

In addition to the federally listed species, the FS has identified 27 sensitive species that can potentially occur within the project area. Potential impacts to these species are briefly addressed below.

Based on the absence of suitable habitat, three species, the common loon, black-backed woodpecker, and tawny-crescent butterfly, are not expected to occur within the project area. Therefore, no impacts to these species resulting from the proposed action are expected.

Six species also identified as USFS sensitive species, plains topminnow, American bittern, greater sandhill crane, white-faced ibis, fox sparrow, and Lewis' woodpecker have the potential to occur within the project area. As a result, these species may be impacted as their habitats are disturbed. The magnitude of local disturbance and relative location of species occurrence will dictate the importance of these potential impacts.

The remaining eighteen USFS sensitive species listed below, as well as the black-tailed prairie dog, have a high likelihood of occurrence or are known to occur within the project area.

- Flathead chub
- Northern leopard frog
- Tiger salamander
- Milk snake
- Black-Hills red-bellied snake
- Townsend's big-eared bat
- Fringed-tailed myotis
- Swift fox
- Western yellow-billed cuckoo
- Long-billed curlew
- Mountain plover
- Ferruginous hawk
- Merlin
- Western burrowing owl
- Loggerhead shrike
- Upland sandpiper
- Baird's sparrow
- Black tern

Habitats for these species can be evaluated individually and impacts can be minimized or eliminated by applying site-specific measures. A variety of effective measures are available to minimize or eliminate potentially adverse effects. The application of these measures would be coordinated with the U.S. Fish and Wildlife Service through the Section 7 consultation process. The Biological Assessment for this PA is attached as **Appendix D** to this EA.

Under the proposed action, impacts to protected and sensitive species are expected to be similar as described in the Wyodak EIS. Surface and associated habitat disturbance from implementation of the PA would total approximately 3,450 acres (0.15 percent) of the 2,317,000-acre Wyodak project area. Short-term disturbance and direct loss of habitat of up to 3 years would be estimated at 1,553 acres. Long-term, direct disturbance of habitat would total 1,847 acres. Potential impacts to these species and their habitats would be analyzed and addressed site-specifically. Impacts will then be minimized or eliminated by applying appropriately developed site specific procedures and precautions.

CULTURAL RESOURCES

Impacts to traditional cultural properties, sacred sites, and localities of traditional concern, such as medicinal plant collecting areas, from implementation of the PA would be similar to those described for the approved action of the Wyodak EIS. Because the locations of wells and facilities are not established and cannot be compared directly to the distribution of known sites and previous cultural resource inventories, no accurate estimates can be made of how many significant historic properties may be affected by the PA. Based on the results of previous investigations, and assuming that sites are evenly distributed throughout the project area, approximately 4.9 sites are estimated per square mile. This distribution estimate is based on the results of the extensive files search conducted for the approved action in the Wyodak EIS and an update of inventory data that has been compiled since the completion of the Wyodak EIS.

Only about 3.8 percent of the project area for the PA has been inventoried for the presence of cultural resources. The largest numbers of identified sites have been prehistoric lithic scatters and historic ranching sites. As of the date of the literature and files search, 192 of the 2,157 known cultural resources (approximately nine percent) have been recommended eligible for or listed in the NRHP. If it is assumed that the areas that have been inventoried for cultural resources are representative of the range of settings in the project area and that cultural sites are randomly distributed across the landscape, there could be as many as 4,000 eligible cultural resources in the project area for the PA. This indicates that there is a high potential for additional significant cultural properties being discovered when cultural resource inventories are undertaken during the APD approval process.

Based on current information, direct impacts to significant cultural properties cannot be precisely identified. The likelihood that additional significant cultural properties would be found in the area of potential effect of the proposed wells and related facilities is high. The direct impacts to nonrenewable cultural resources are considered the same regardless of whether the well is a drilled well or a producing well. Because of the permanent nature of surface- and subsurface-disturbing activities on cultural resources, all impacts are

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considered long-term impacts. Given the assumptions of 1.38 acres of ground disturbance per well, 4.9 sites per square mile, and that approximately 9 percent of the sites would be significant, the PA would likely have direct impacts on 26 resources, two of which are likely to be significant, requiring avoidance or mitigation. It can be seen that for all of the new wells (federal, state, and fee), approximately 56 cultural resource sites may be impacted, and five of those are likely to be significant and require avoidance or mitigation measures. This is fewer than the number of resources projected to be impacted by the 5,000 federal wells that were proposed for development under the approved action in the Wyodak EIS. Under the approved action, it was projected that there would be 26,491 acres of potential direct disturbance, approximately 352 cultural resource sites would be impacted by the PA, and 42 of those would likely to be significant and require avoidance or mitigation measures.

Indirect impacts to cultural resources, such as increased vehicular traffic and vandalism, are difficult to estimate until the locations of the wells and ancillary facilities are known. Indirect impacts would increase as the number of producing wells increases because of continued use of the area.

All areas of proposed ground disturbing activity would be inventoried for cultural resources at the APD phase of each action. Any discovered cultural resources would be evaluated for eligibility to the NRHP. It should be possible to avoid direct impact to many significant properties, but construction and operation of the proposed wells and facilities may have indirect effects. Indirect effects may result from traffic or other activities outside the identified areas of disturbance, or from changes to soil stability or drainage patterns. Indirect effects can be minimized by soil stabilization measures and protective barriers to restrict traffic in sensitive areas.

Where direct effects cannot be avoided, an approved data recovery plan would be developed in consultation with the SHPO to attempt to mitigate the adverse impacts of the PA. (Data recovery itself is considered an adverse impact to archaeological sites, and avoidance is the preferred mitigative strategy.) Specific plans for avoidance or data recovery would be recommended for any significant sites within the area of potential effect of the proposed activities. Data recovery would collect a statistically valid sample of those data elements that make the site significant and would be unavoidably disturbed or destroyed by the proposed undertaking. Certain historic sites, such as significant historic trails, may be significant for their setting and context, and may be sensitive to visual intrusions that must be mitigated by modifications to location and design of the proposed project. In addition, specific procedures will be established for the treatment of unanticipated discoveries and unmarked human remains that are not identified by surface cultural resource inventory.

A large number of cultural properties within the project area remain unevaluated. When the literature search for a proposed project indicates that an unevaluated site occurs, the operator has the option of relocating the project or assessing the site to determine significance. If portions of a site do not contribute to significance, the project could be located on that portion.

LAND USE AND TRANSPORTATION

Land Use

Potential impacts to land uses and transportation from implementation of the PA would result from curtailed or constrained activities or productivity within the project area, from limited or prohibited access that removes land from existing uses, or from surface disturbance necessary for proposed CBM facilities. These impacts are consistent with those described in detail for the approved action analyzed in the Wyodak EIS. The PA would also be consistent with the BLM RMP and the FS LRMP, which provide for multiple land uses, and also with city and county planning efforts.

Both short- and long-term direct impacts to land use are anticipated from implementation of the PA. Short-term direct impacts would result from the clearing of or damage to vegetation and disturbance of soils for pipeline construction. The previous land use would be reestablished within approximately 3 years following implementation of reclamation measures. Long-term direct impacts would result from the construction and operation of facilities that would be maintained for at least the life of the project. These facilities include the two-track and upgraded access roads, well sites, and pod facilities. The predominant land uses likely to be impacted by the project are agricultural grazing and some crop production and wildlife habitat and to a lesser extent, coal mining, rural residential, and recreation.

Indirect impacts, such as possible inundation of lands and modification of their use by discharged produced water, are expected to be minimal and isolated in occurrence. Recent BLM information (Meyer 2000) indicates stream infiltration and evapotranspiration rates are such that in most cases produced waters from existing producing wells are generating stream channel flows for only limited distances below discharge points. Also, where natural flows exist, produced water discharges are not making significant, measurable contributions to streamflows at established downstream monitoring sites.

Federal surface (8.5 percent federal) and mineral estate (50 percent federal) ownership is not expected to change due to implementation of the PA. Surface use and right-of-way approvals would be obtained from appropriate federal, state, and local agencies.

The anticipated acreage of disturbance from the PA's drilling of the 2,500 wells, construction of facilities, and field operations is 3,450 acres, based on the 1.38-acres per well disturbance factor defined in Chapter 2. Of this total, short-term disturbance and direct loss of productivity for the dominant livestock grazing and wildlife habitat uses for up to 3 years would be 1,553 acres. Long-term, direct disturbance and loss of grazing land and wildlife habitat would total 1,897 acres. The estimated total disturbance for the PA (3,450 acres) represents 0.15 percent of the total acreage (2,317,000 acres) included in the Wyodak project area. The 3,450 acres of new disturbance represents an additional disturbance of 13 percent over the 26,491 acres of disturbance analyzed under the selected alternative in the Wyodak EIS.

Transportation

Impacts related to use of highways and roads in the Wyodak project area from implementation of the PA are expected to be similar to those described in the Wyodak EIS analysis. The similarity also would likely include a comparable rate of well and facility development including drilling and completion, access road construction, pipeline construction, pod facilities construction, and initial well production and field operations. Based on the rate of development for 5,000 new wells of the approved action in the Wyodak EIS in comparison to 2,500 new wells under this EA's PA, and personnel requirements for the Wyodak EIS PA (DEIS, Table 4-14), the following assumptions apply to implementation of this EA's PA:

- Twenty-five to 30 operating drill rigs on a monthly basis,
- Absence of new compressor station construction and operation and need for workers, and
- A personnel need under this EA's PA for remaining field development activities that is roughly one third of the workers projected for the approved action in the Wyodak EIS.

Based on these assumptions, transportation-related impacts from implementation of the EA's PA would include the following:

- Project-related traffic levels would consist of approximately 130 vehicles for drilling, construction and maintenance operations and 9,000 miles of travel per day during the 15-month implementation period for the PA.
- Project-related traffic would be dispersed throughout the 3,600 square-mile project area (approximately four vehicles per 100 square miles), and would not result in a large increase in traffic on state and local roads during the initial development period or during production operations.
- Traffic on roads crossed by any of the proposed pipelines or power lines would experience relatively minor delays during construction, caused by lane closures.

RECREATION

Impacts from implementation of the PA would be similar to those described for recreation for the selected alternative in the Wyodak EIS. Access for recreational uses to most of the project area would remain limited due to the predominance of private surface ownership even though the PA would increase potential access within the project area with the construction of additional roads. Opportunities for dispersed recreation exist on federal and state lands, but little use is known to occur. No developed recreational sites are located on federal or state lands within the project area.

Of the limited dispersed recreational opportunities, hunting is the primary recreational activity. The direct impact of long-term disturbance of approximately 1,897 acres (0.08 percent of the project area) that would likely occur with implementation of the PA would have minimal adverse impacts on recreational activities occurring in the project area. Subject to landowner discretion, discharged produced water may be impounded and stocked with fish to enhance fishing opportunities in the project area.

VISUAL RESOURCES

Impacts to visual resources of federal lands in the project area from the implementation of the PA would be similar to the short- and long-term impacts described in the Wyodak EIS, differing only in the increased number of wells and other facilities. The visual intrusion of these activities would be site specific and would not likely affect visitors outside the immediate viewshed of each facility. The impacts to the characteristic landscape are expected to be similar to those described for the Wyodak EIS, which are summarized below.

- Short-term impacts would consist of construction activities and linear disturbance associated with pipeline construction, and would likely be evident to people using nearby roads within the project area.

- Users of the area may be impacted by the sight and the dust of construction activities.

- The transport of equipment and materials to work sites would likely be evident to other travelers on local highways and roads used to access the project area.

- Long-term impacts would occur over the life of the project from the addition of the well and pod facilities to the landscape, and the linear disturbance of corridors for two-track and upgraded access roads.

- The most visible components of the proposed facilities are expected to be wellhead facilities at each productive well, production pod facilities, and improved roads to production pods.

Most of the proposed wells on BLM lands within the project area would likely be located on BLM VRM Class IV lands. The construction and operation of each well and the ancillary facilities would be consistent with VRM Class IV objectives, provided that every attempt is made to minimize the adverse visual impacts through careful location of facilities, minimal disturbance of the site, and design of facilities so that they harmonize with the surrounding landscape. Consequently, none of the disturbed acreage would be displaced from the existing BLM inventory of lands managed with VRM Class IV. The proposed facility developments would be consistent with management objectives.

Proposed wells may also be located in VRM III areas, which include BLM lands in the Fortification Creek Wilderness Study Area (west-central part of project area) and Indian Butte (southwest project area). The proposed facilities would contrast with the basic landscape elements, but would remain subordinate to the existing landscape character, which includes existing oil and gas developments. Consequently, none of the disturbed acreage would be displaced from the existing BLM inventory of lands managed as VRM Class III. Proposed facility developments would be consistent with management objectives. It is not likely that any proposed wells would be located in VRM Class II. The Wyodak CBM EIS describes these lands as private lands adjacent to highways in the project area.

All proposed wells and facilities under the PA would be consistent with FS visual quality objectives for the Thunder Basin National Grassland. Adverse visual impacts would be minimized through careful location of facilities, minimal disturbance of affected sites, and design of facilities so that they harmonize with the surrounding landscape on both FS- and BLM-administered lands.

NOISE

Impacts from elevated noise levels produced by implementation of the PA above the general rural background noise level of 35 to 40 dBA could occur during well drilling and facilities construction. Construction/drilling-related noise would result from drill rig operations, construction equipment operations, and transport vehicle traffic. However, activities in any one location would be of limited duration measured in days. Individual sites of noise-producing activity would be mostly widespread; thus, elevated noise levels from separate sites would likely not overlap in time or space.

SOCIOECONOMICS

Implementation of the PA would result in CBM production from 1,425 protective federal wells. Each well is expected to produce an average of 238 mcf per day over the projected 15-month period, for an average of 108,528 mcf over the entire 15-month period for each well. The proposed 1,425 productive wells would generate approximately 155 bcf over the 15-month period. Assuming a unit cost of $2.85 per mcf ($3.00/MMBTU)(constant 2000 dollars) over the 15-month period, each well would generate an estimated sales value of $309,305.00 (constant 2000 dollars) over the 15-month period. Under the PA, CBM production is expected to contribute sales valued at $441 million (constant 2000 dollars) over the 15-month period to the local, state, regional, and national economies.

Impacts to the socioeconomic structure of Campbell, Converse, Johnson, and Sheridan counties, including population, housing, and employment would be similar to those impacts described for the approved action analyzed in Wyodak EIS.

Employment and Personal Income

The workforce required for initial development and long-term operations for the PA would be approximately one-third of the workforce proposed for the approved action analyzed in the Wyodak EIS, and consists of a part of the same workforce currently installing the fee and state wells as described in the Wyodak EIS.

- Initial development workforce of about 256 employees.
- Long-term workforce of about 154 employees.
- Stimulation of an additional 216 jobs by long-term employment (indirect employment) as determined by an employment multiplier of 2.4. About 108 (50 percent) of these jobs would be created within the affected counties.
- Stimulation of an additional 358 jobs by initial development workforce employment, including 179 jobs in the affected counties.
- $8,227,000 (2000 dollars) in wages and salaries paid to long-term project employees over life of project. $13,676,000 in wages and salaries paid to short-term initial-development employees.

The overall positive impact of wages and salaries will be considerably less for the PA than the impact of the Wyodak CBM project because of the shorter time frame. The salaries and wages earned by the PA workforce were determined by using a conversion factor of 1.05 (USBLS 2000) to convert the 1998 wages and salaries estimated in the Wyodak EIS to 2000 dollars. The annual average 1998 income of $40,700 for the workforce would be $42,735 in 2000 dollars, resulting in an average wage of $53,420 over 15 months. The PA would result in $8,227,000 (2000 dollars) in wages and salaries paid to long-term project employees over the 15-month period. Another $13,676,000 in wages and salaries would be paid to short-term initial-development employees. The 108 long-term support industry jobs (indirect employment) would result in $5,769,000 in wages and salaries in the affected counties. The 179 short-term support industry jobs would result in $9,562,000 in wages and salaries. The economic impact to the affected counties from direct and indirect employment would total $37,234,000.

Federal Royalty and Production Taxes

For the purpose of this analysis, federal royalties have been estimated as $38,663 per federal well (using 12.5 percent of the estimated sales value of $309,305 per well). All of the proposed wells would be federal wells. The proposed project would generate estimated federal royalties of $55,095,000 (constant 2000 dollars) over a 15-month period. Natural gas produced from federal properties is not subject to state severance or ad valorem taxes. However, approximately one-half of the federal royalties, or about $27,547,000, would be distributed to the State of Wyoming.

Sales and Use Taxes

The taxable value per well is estimated to be $31,500. This figure was calculated by applying an estimated factor of 60 percent (taxable goods and services) to a total well cost of $51,425 (Barrett Resources 1998). The five percent sales and use tax is estimated to be $1,575 per well (0.05 x $31,500). There are a total of 1,425 producing wells proposed for the project, which would result in total sales and use taxes of

$2,244,000 (constant 2000 dollars) paid to the state and the counties over the period of time that taxable goods and services are purchased (15 months).

Housing and Community Resources

There would be 256 workers required for the initial development and 154 workers required for long-term operational phases. This workforce would be hired primarily from the workforce currently employed for CBM development in the project area, as evaluated in the Wyodak EIS. There would be no additional impacts to housing and community resources to those evaluated for the approved action analyzed in the Wyodak EIS.

Local Economic Impact

During the initial development period, CBM development under PA would support the equivalent of 984 full-time positions (256 short-term project employees, 358 short-term support industry jobs, 154 long-term project employees, and 216 long-term support industry positions).

The estimated economic impact to the local counties from direct and indirect employment over the life of the project from personal income and sales/use taxes would include the following: 1) $14.0 million (long-term employment); 2) $23.2 million (short-term employment); and 3) $2.2 million (sales and use taxes). This economic impact would total nearly $39.4 million over15 months (constant 2000 dollars). This is nearly seven percent of the $600 million projected for the approved action analyzed in the Wyodak EIS.

In addition, the State of Wyoming would receive an estimated $27.5 million (in constant 2000 dollars) in federal royalties over the 15-month period. Some of these monies also would be used to benefit the local counties. The proposed CBM productions would occur over a 15-month period, in contrast to the 12- to 15-year period of time analyzed in the Wyodak EIS. However, the estimated $27.5 million is nearly 35 percent of the contribution of $82 million in federal royalties that was projected in the Wyodak EIS, because the price of natural gas has increased substantially between 1998 and 2000 and because existing wells have produced larger quantities of natural gas (average of 238 mcf/day) than projected in the Wyodak EIS (average of 125 mcf/day).

Environmental Justice

The implementation of the PA and its potential disproportional adverse impacts on minority and/or low-income groups, including Native Americans, were considered in this analysis; however, the absence of issues and identification of any impact to such a group results in a determination of no disproportionate impact.

CUMULATIVE IMPACTS

The PA's direct and indirect effects would combine with the effects of the Wyodak alternative selected and implemented in the ROD, which would result in cumulative impacts. **Table 4-1** summarizes these cumulative impacts. The sections following the table discuss the impacts in more detail.

Table 4-1
Summary of Cumulative Impacts

Resource/Issues	EA PA	EA PA plus Actual	Wyodak EIS Approved
Geology & Minerals	1,425 producing wells	7,129 producing wells	5,890 producing wells
Water Resources	5,518 producing wells as of 2/28/02 (1,425 federal protective wells plus 4,093 existing wells) 11.1 gpm per well groundwater production and surface discharge 88.2 mgd 82,900 acre-feet per year minimal water quality impacts per regulatory standards for discharge	7,129 producing wells as of 2/28/02 (5,518 producing wells plus 1,611 additional state and fee wells) 11.1 gpm per well groundwater production and surface discharge 113.9 mgd 107,660 acre-feet per year minimal water quality impacts per regulatory standards for discharge	5,890 producing wells 12 gpm per well groundwater production and surface discharge 101.8 mgd 114,030 acre-feet per year minimal water quality impacts per regulatory standards for discharge
Air Quality	negligible fugitive dust emissions 5.4 tons/year NO_x from vehicle emissions 0.004 pound NO_x per acre per year	negligible fugitive dust emissions 29.7 tons/year NO_x from vehicle emissions 0.025 pound NO_x per acre per year	negligible fugitive dust emissions 18 tons/year NO_x from vehicle emissions 0.016 pound NO_x per acre per year
Soils	3,450 acres of total disturbance for 2,500 wells and facilities	17,251 acres of disturbance	26,551 acres of disturbance
Vegetation Resources	3,450 acres of total disturbance for 2,500 wells and facilities	17,251 acres of disturbance	26,551 acres of disturbance
Wetlands	avoidance/minimal	avoidance/minimal	avoidance/minimal

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Table 4-1 (continued)
Summary of Cumulative Impacts

Resource/Issues	EA PA	EA PA plus Actual	Wyodak EIS Approved
Wildlife and Fisheries	3,450 acres of total habitat disturbance for 2,500 wells and facilities	17,251 acres of habitat disturbance	26,551 acres of habitat disturbance
Special Status Species	3,450 acres of total habitat disturbance for 2,500 wells and facilities	17,251 acres of habitat disturbance	26,551 acres of habitat disturbance
Cultural Resources	26 sites may be affected, of which 2 are likely to be significant and require avoidance or mitigation	132 sites may be affected, of which 12 are likely to be significant and require avoidance or mitigation	352 sites may be affected, of which 42 were likely to be significant and require avoidance or mitigation
Land Use	3,450 acres of total disturbance for 2,500 wells and facilities	17,251 acres of disturbance	26,551 acres of disturbance
Transportation	130 vehicles traveling about 9,000 miles per day	760 vehicles traveling about 49,400 miles per day	480 vehicles traveling about 30,000 miles per day
Recreation	minimal	minimal	minimal
Visual Resources	compatible effects	compatible effects	compatible effects
Noise	short-term localized	short-term localized	short-term localized
Socioeconomics	$441 million in sales of CBM $134.0 million contribution to economy and federal, state, and local taxes and royalties	$2,204.8 million in sales of CBM $551.2 million contribution to economy and federal, state, and local taxes and royalties	$1600.0 million in sales of CBM $776 million contribution to economy and federal, state, and local taxes and royalties

Geology and Mineral Resources

Except for the removal of methane, loss of federal CBM without compensation and possible conflicts with coal leases, no cumulative effects on geology and minerals are anticipated from implementation of the PA in conjunction with past, current, and projected CBM development in the Wyodak project area over the 15-month implementation period for the PA.

Water Resources

Implementation of the PA in conjunction with past, current, and anticipated CBM development would contribute to cumulative effects to surface water and groundwater resources over the 15-month implementation period for the PA. Cumulative impacts would result from the withdrawal of groundwater from underground coal aquifers and the subsequent discharge of this produced water upon the land surface in established drainageways or water storage facilities. The quantity and quality of surface water flows would be affected by the quantity and water chemistry of the produced water.

Water volumes produced from CBM wells within the project area are expected to increase from 65.4 million gallons per day (mgd), for an estimated 4,093 CBM wells producing as of November 30, 2000, to a estimated cumulative maximum water production of 113.9 mgd with the addition of the PA's 1,425 producing federal wells and 1,611 producing state and fee wells within the 15-month implementation period. The annual rate of water production as of the end of the 15-month period (February 28, 2002) would be approximately 107,660 acre-feet. The maximum volume of water to be produced annually under the approved action for the Wyodak EIS was estimated to be 101.8 mgd or 114,030 acre-feet per year (Wyodak FEIS, p. 4-63). The comparison between the projected volumes of water to be produced daily and annually under the PA in combination with existing and concurrent state and fee well water production and the volumes for the approved action in Wyodak EIS indicates CBM-generated flows for the PA would be greater than those volumes estimated in the Wyodak EIS. The range and magnitude of cumulative impacts from implementation of the PA would exceed those cumulative impacts assessed and approved for approved action analyzed in the Wyodak EIS. Again, stream flows including discharged produced water and associated impacts would likely be mitigated by downstream infiltration and evapotranspiration.

As the annual rate of water production for the PA in combination with existing and anticipated state and fee wells is less than the maximum annual rate projected and analyzed in a calibrated groundwater model of the region, cumulative drawdown of water levels in the project area's underlying coal aquifer from PA implementation is anticipated to be less than the drawdown that was projected for the approved action in the Wyodak EIS. Water production under the PA in combination with existing and anticipated state and fee wells would occur at an annual rate of 107,660 acre-feet per year. This rate is less than the maximum projected annual rate of 114,030 acre-feet per year for the approved action analyzed in the Wyodak EIS. The total volume of water (127,497 acre-feet) that would be produced by the end of the 15-month implementation period for the PA, existing, and anticipated new wells is less than the total amount of water (1.7 million acre-feet) that would be pumped from the coal aquifer for the life of the approved project analyzed in the Wyodak EIS. Thus, the areal extent and magnitude of expected aquifer drawdowns projected for the PA in combination with existing wells would be less than those drawdowns that were projected for the approved action analyzed in the Wyodak EIS.

Cumulative effects to water quality from implementation of the PA are expected to be minimal or at least acceptable based on the quality of the discharged produced CBM water meeting regulatory standards. Water quality standards and CBM produced water (effluent) limitations are established by the WDEQ and administered on a case by case basis. CBM produced water from any CBM well cannot be discharged to the surface unless the discharge meets WDEQ and other agency requirements. Produced water from all CBM wells must first be characterized by the operators and presented to the WDEQ as supporting information in order to obtain approval for the proposed CBM discharge. The WDEQ analyzes water pollution potential based on the produced water quality and the existing water quality of the receiving stream specific to a limited area. Thus, although produced water quality from cumulative CBM well production may be somewhat variable, the WDEQ would mandate adherence to requirements so that all discharges represent the water characteristics necessary for continued safe consumption or use of water downstream by humans and other species.

Air Quality

Implementation of the PA in conjunction with past, current, and anticipated CBM development would likely contribute to cumulative effects to air quality over the 15-month implementation period. Cumulative effects would result from fugitive dust emissions, in the form of PM_{10}, generated by vehicular traffic. Based on the formula for estimating fugitive dust emissions from vehicles on unpaved roads presented in the Wyodak EIS and the estimate for the PA's cumulative disturbance acreage, the projected amount of dust to be generated by the 12,501-well field would likely be roughly two thirds of levels estimated for the approved action (Wyodak ROD). Since the calculated fugitive dust emission levels for the approved Wyodak project were determined to negligible, fugitive dust emissions would be negligible for the cumulative impacts. Any dust generated by vehicles at a given location would be localized and short-term.

NO_x emissions would also result from project vehicle exhausts. Calculation of the emissions using an EPA methodology and a NO_x emissions factor of 1.5 gm NO_x per vehicle mile (USEPA 1991) resulted an estimate of 163.2 lbs of NO_x ((1.5 gm/mile x 49,400 vehicle miles)/454 gm/lb) would be produced per day, or about 29.7 tons per year. Distributing these project emissions over the 2,317,000-acre project area would result in a vehicle emissions factor and yield of 0.025 pound NO_x per acre per year.

Soils

Implementation of the PA would contribute to cumulative effects to soils within the Wyodak project area for the PA's 15-month implementation period. Cumulative effects would result from the past, current, and future removal of protective vegetative cover and disturbance of soils by excavation, blading, and/or compaction. Impacts would be similar to those described for direct and indirect impacts from implementation of the PA, but the magnitude would be greater with the addition of past disturbance approved by the Wyodak EIS and projected concurrent disturbance on state and fee lands. Short-term-specific impacts would include loss of productivity and accelerated soil erosion and loss from construction corridors for pipelines prior to successful reclamation and mitigation of impacts. Overall long-term impacts would include loss of productivity, soil mixing, and breakdown of soil structure in areas occupied by well and pod facilities and access roads. Indirect effects would include increased runoff from compacted soil surfaces and off-site sedimentation and possible salinization of down-gradient streams. Cumulative disturbance of soils would result from the drilling of 2,500 federal protective wells and construction of associated facilities and, the anticipated drilling of about 2,824 state and fee wells and construction of facilities during the 15-month period in combination with disturbance from 7,176 existing wells and associated facilities (as of November 30, 2000). Application of the 1.38-acre per well factor for disturbance to the cumulative well count of 12,501 wells to be drilled by the end of the 15-month period (February 28, 2002) produces a total, estimated, cumulative disturbance of 17,251 acres (0.7 percent of Wyodak project area).

Vegetation, Wetlands, Wildlife, and Special Status Species

Implementation of the PA would contribute to cumulative effects to vegetation resources and wildlife and special status species within the Wyodak project area for the PA's 15-month implementation period. As no impacts to wetlands are proposed with implementation of the PA, no cumulative impacts are anticipated. Cumulative effects to vegetation, wildlife, and special status species would result from the drilling of the PA's 2,500 federal protective wells and construction of associated facilities and, the anticipated drilling of about 2,824 state and fee wells and construction of facilities during the 15-month period in combination with disturbance from 7,176 existing wells and associated facilities (as of November 30, 2000). Application of the 1.38-acre per well factor for disturbance to the cumulative well count of 12,501 wells to be drilled by the end of the 15-month period (February 28, 2002) produces a total, estimated, cumulative disturbance of 17,251 acres (0.7 percent of the 2,317,000-acre Wyodak project area).

Short-term cumulative direct disturbance to habitat from pipeline and power line construction, including past and reclaimed lands, reclaimed and recovering lands, and proposed disturbance would total approximately 7,763 acres (45 percent). Long-term cumulative direct disturbance to habitat associated with well and pod facilities and new access roads would total approximately 9,488 acres.

In addition to cumulative impacts associated with the PA's direct impacts, cumulative impacts associated with indirect impacts to wildlife and special status species also may occur, including localized loss of habitats (forage, shelter, and breeding) and subsequently localized alterations in forage and prey species. Despite these potential changes, the availability of suitable resources throughout the entire project area would be sufficient to support resident flora and fauna. Appropriate mitigation measures would be applied to avoid unnecessary direct impacts. Cumulative impacts are not likely to adversely affect currently protected species and are not likely to jeopardize the continued existence of other non-protected species.

Cultural Resources

Implementation of the PA would contribute to cumulative effects to cultural resources within the Wyodak project area for the PA's 15-month implementation period. Cumulative effects would result from the drilling of the PA's 2,500 federal protective wells and construction of associated facilities and, the anticipated drilling of about 2,824 state and fee wells and construction of facilities during the 15-month period in combination with disturbance from 7,176 existing wells and associated facilities (as of November

30, 2000). Application of the 1.38-acre per well factor for disturbance to the cumulative well count of 12,501 wells to be drilled by the end of the 15-month period (February 28, 2002) produces a total, estimated, cumulative disturbance of 17,251 acres. Assuming a site density of 4.9 sites per square mile, approximately 132 cultural resource sites may be impacted by the existing development combined with the PA and foreseeable development of state and fee wells, and 12 of those are likely to be significant and require avoidance or mitigation measures. It is difficult to determine how many of those 12 sites would actually be located on federal and/or state estate and be subject to avoidance or mitigation measures. Because of the permanent nature of surface- and subsurface-disturbing activities on nonrenewable cultural resources, all impacts are considered long-term impacts.

Land Use and Transportation

Implementation of the PA would contribute to cumulative effects to land uses and transportation within the Wyodak project area for the PA's 15-month implementation period. Cumulative effects would result from the drilling of the PA's 2,500 federal protective wells and construction of associated facilities and, the anticipated drilling of about 2,824 state and fee wells and construction of facilities during the 15-month period in combination with disturbance from 7,176 existing wells and associated facilities (as of November 30, 2000). Application of the 1.38-acre per well factor for disturbance to the cumulative well count of 12,501 wells to be drilled by the end of the 15-month period (February 28, 2002) produces a total, estimated, cumulative disturbance of 17,251 acres. Affected land uses would include both the principal historical and existing uses of agriculture/grazing and wildlife habitat. Activities near residential areas would likely increase.

Short-term cumulative disturbance from pipeline and power line construction, including past and reclaimed lands, reclaimed and recovering lands, and proposed disturbance would total approximately 7,763 acres (45 percent). Long-term cumulative disturbance associated with well and pod facilities and new access roads would total approximately 9,488 acres.

The combination of existing vehicle activity (480 vehicles traveling about 30,000 miles per day), proposed vehicle activity under the PA (130 vehicles traveling about 9,000 miles per day), and anticipated vehicle activity from concurrent CBM development on state and fee wells (150 vehicles traveling about 10,400 miles per day) would result in an increase of about 60 percent in the project area for active vehicles on a daily basis, the result would be about 2 vehicles for every 10 square miles, assuming equal distribution of vehicles throughout the Wyodak project area.

Recreation

Cumulative impacts to recreational opportunities would be minimal with implementation of the PA in combination with past and concurrent CBM development over the 15-month implementation period for the PA. The limited opportunities for dispersed recreational activities like hunting and fishing may be enhanced with the addition of roads constructed as part of the PA and the concurrent development on state and fee lands. Access would remain limited due to the predominance of private ownership. The cumulative impact of long-term disturbance of approximately 6,876 acres (0.3 percent of the project area), that would likely occur with implementation of the PA, would have minimal adverse impacts on recreation. Subject to landowner discretion, discharged produced water may be impounded and stocked with fish to enhance fishing opportunities in the project area.

Visual Resources

The cumulative effects to visual resources in the Wyodak project area would result from implementation of the PA along with past and concurrent CBM development over the 15-month implementation period. Views would be changed by an increase in numbers of wells, pod facilities, roads, and pipelines; however, this increase would not change the visual character of the existing rural landscape in the project area, which includes considerable modification from oil and gas activities and coal mining.

Noise

Cumulative impacts from elevated noise levels produced by implementation of the PA in conjunction with past and concurrent CBM development would not be expected to be noticeable to visitors or residents within the Wyodak above the general rural background noise level of 35 to 40 dBA could occur during well drilling and facilities construction. Construction/drilling-related noise would result from drill rig operations, construction equipment operations, and transport vehicle traffic. However, activities in any one location would be of limited duration measured in days. Individual sites of noise-producing activity would be mostly widespread; elevated noise levels from separate sites would likely not overlap in time or space.

Socioeconomics

A total of 7,129 CBM wells are either existing or projected for development over the fifteen-month implementation period for the PA, including wells on federal, state, and fee mineral estates. Cumulative CBM production is expected to contribute sales valued at an estimated $2,204.8 million over the 15-month period (**Table 4-2**). The impact to the local economy, and to federal, state, and county governments from taxes and royalties would total approximately $551.2 million. It is anticipated that the current available workforce would be used and sufficient for implementation of the PA in the project area, and that there would be none to minimal additional impacts to community facilities and services as the workforce.

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Table 4-2
Cumulative Economic Impact for Proposed CBM Production

	Proposed Action	Existing Federal Wells	Existing State & Fee Wells	Projected State & Fee Wells	TOTAL
Number of Producing Wells	1,425	573	3,521	1,610	7,129
Sales Value	$440.8 million	$177.2 million	$1,088.8 million	$498.0 million	$2,204.8 million
Direct/Indirect Employment	$37.2	$68.7 from Wyodak CBM development scenario, includes Proposed Action employment			$68.7
Federal Royalty	$55.1 million	$22.2 million	0	0	$77.3 million
Federal Royalty Returned to State	$27.6 million	$11.1 million	0	0	$38.7 million
State Royalty	0	0	$181.5	$83.0	$264.5
Severance & Ad Valorem Taxes	0	0	$136.1 million	$62.2 million	$198.3 million
Sales and Use Taxes	$2.2 million	$0.9 million	$5.5 million	$2.5 million	$11.1 million
TOTAL	**$566.8 million**	**$200.3 million**	**$1411.94 million**	**$645.7 million**	**$2824.7 million**

Notes: Calculated using 2000 dollars and spot gas price of $2.07 per mcf.
Federal royalties are an estimated $38,663 per federal well
State royalties are an estimated $51,561 per state well (State royalty - 16.67 percent)
Sales and Use taxes are $1,575 per well
Federal Royalties Returned to the State of Wyoming are not included in Totals because they are also included in Federal Royalties.

CHAPTER 5
CONSULTATION AND COORDINATION

SCOPING PROCESS

The scoping process and public participation are addressed in the "Public Participation" section of Chapter 1 of this EA.

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Consultations and Coordination

State of Wyoming

The BLM notified the Wyoming State Office of Federal Land Policy of its intent to prepare this EA. Through notification of the Office of Land Policy, all state agencies, including the governor's office, were notified.

Native American Consultation

Native American Representatives Contacted for the Wyodak Drainage CBM EA.

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CHAPTER 6
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APPENDIX A
WETLANDS MANAGEMENT GUIDANCE

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United States Department of the Interior
BUREAU OF LAND MANAGEMENT
Wyoming State Office
P.O. Box 1828
Cheyenne, Wyoming 82003-1828

BLM CASPER
STAFF
__ SUPPORT
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✓ SOLIDS
PRRA CRA CARA

FEB 01 1999

Jim
Jake
Glen

In Reply Refer To:
1610 (930) P
1737
3400

January 28, 1999

Instruction Memorandum No. 99-19
Expires: 09/30/00

To: Field Managers

From: Deputy State Director, Resources Policy & Management

Subject: Protection of Wetlands in Coal Screening, Planning, and Leasing

The Bureau of Land Management wetland policy is found in BLM Manual 1737 (Riparian-Wetland Area Management) dated December 10, 1993. Among the Authorities listed in the Manual is Executive Order (EO) 11990, May 24, 1977 (Protection of Wetlands) which is one of the primary sources for BLM policy on the protection of wetlands. EO 11990 directs Federal agencies to take action to minimize the destruction, loss, or degradation of wetlands and to preserve and enhance the natural and beneficial value of wetlands in carrying out programs affecting land use. BLM policy and the EO are interpreted to cover all wetlands, not just jurisdictional wetlands, which are under the purview of the Army Corps of Engineers (COE).

The standard operating procedure in most Field Offices involving the protection of wetlands is that when a project or use authorization proposal on the public lands is submitted, the National Wetlands Inventory (NWI) maps are consulted. If the maps show that any wetland might be impacted, the area is field checked and the *Surface Disturbance Mitigation Guidelines* are used in the analytical (NEPA) process to determine the appropriate mitigation to be applied. Digitized NWI maps are available for the BLM administered public lands in the western 3/4 of the State; paper maps, with some scattered digitizing, are available for most of the eastern 1/4 of the State.

Wyoming's current *Surface Disturbance Mitigation Guidelines* are found in approved RMPs and include the following provisions in one form or another:

> "Surface disturbance will be prohibited in any of the following areas or conditions. . . .
>
> c. Within 500 feet of surface water and/or riparian areas." (Note that the term "surface water" covers all types of wetlands which by definition exhibit some surface water, at least temporarily, in some years).

The guidelines further state that no disturbance will occur within these areas unless an acceptable plan for mitigation is agreed upon.

Wetland protection in recent planning amendment and draft coal environmental analysis documents, and possibly in practice in the Field Offices, has been ambiguous; in other words, it is difficult to determine if BLM is considering jurisdictional or "all wetlands" in the analysis. A recent wetlands study prepared for WO shows a wide difference in acreage between jurisdictional and total wetlands on tracts in the Powder River Basin. Jurisdictional wetlands have been protected in both the planning documents and in practice, but other wetlands identified on the NWI maps also should be protected. This approach follows the Forest Service which uses the procedure outlined in the preceding paragraphs on the National Grasslands in the Powder River Basin. They cite EO 11990 and require disturbance of all wetlands in Federal coal areas to be mitigated acre for acre. BLM's policy will do no less.

Disturbance to jurisdictional wetlands is routinely evaluated during the environmental analysis process and mitigated under the direction of the Office of Surface Mining and the Wyoming Department of Environmental Quality. All other wetlands on BLM surface and on other ownerships overlying Federal coal (split estate) also must be addressed in the environmental analysis and the associated documents. During environmental document preparation, BLM is responsible for coordination of mitigation on BLM surface as well as on private surface overlying Federal coal. Owners of surface wetlands on split estate lands may coordinate with the BLM, within the restrictions of any State regulations, as to the nature of their reclaimed lands, i.e., a land owner may not want a bog (a livestock death trap) rebuilt on his reclaimed private surface. This coordination should result in a waiver, or some other document, signed by the surface owners showing what they want done with the reclaimed lands.

Please review your planning documents and office practices to assure that Wyoming BLM is in full compliance with the Bureau's wetland protection policy. This is an on going topic in the WO and in the Federal courts. A WO evaluation of wetland protection efforts for each Field Office in coal producing areas might be anticipated within the next few years. If you have any questions, please call Mark Gorges at 307-775-6100, Joe Patti at 307-775-6101, or Mel Schlagel at 307-775-6257.

Distribution
Director (200), Room 5650, MIB 1
CF 2

DEPARTMENT OF THE ARMY
CORPS OF ENGINEERS, OMAHA DISTRICT
215 NORTH 17TH STREET
OMAHA, NEBRASKA 68102-4978

February 19, 1998

REPLY TO
ATTENTION OF

Wyoming Regulatory Office
2232 Dell Range Blvd., Suite 210
Cheyenne, Wyoming 82009

FEB 24

Mr. Richard Zander
Bureau of Land Management
Buffalo Resource Area
1425 Fort Street
Buffalo, Wyoming 82834-1425

Dear Mr. Zander:

This is in reference to your agency's January 27, 1998 notification of a scoping meeting for the Gillette South Coal Bed Methane Environmental Impact Statement. The EIS is to address impacts from the installation of approximately 2600-3000 new wells. That notice also solicited comments in regards to other agency requirements.

The Corps of Engineers regulates the discharge of dredged and fill material into waters of the United States (including wetlands) as authorized primarily by section 404 of the Clean Water Act (33 U.S.C. 1344). The issues sheet attached to your request inaccurately states that wetlands created by the discharge of water (assumedly from coal bed methane production activities) do not come under the jurisdiction of the U.S. Army Corps of Engineers. My staff contacted you on February 12 and discussed this issue as well as the Corps' jurisdiction and potential permitting requirements associated with these type of areas. You requested that we provide clarification relative to what are jurisdictional areas and when permits are needed.

Jurisdictional Areas

As previously stated, we regulate the discharge of dredge and fill material (which includes excavation) into certain areas known as waters of the U.S. Before any individual or entity needs to obtain authorization in accordance with Section 404 of the Clean Water Act, a jurisdictional area, known as a water of the U.S. (which includes wetlands) must be involved. Waters of the U.S. are defined at 33 CFR Part 328 in the November 13, 1986 Federal Register on page 41250 and 41251. Additional clarification to these areas is found on page 41217 of the same Federal Register. The most common waters of the U.S. found in the Gillette area typically include, but are not limited to, intermittent and ephemeral draws, creeks and rivers, playa lakes, and wetlands.

N9

Note that the mere presence of these areas on an individual's property does not require authorization as does the undertaking of regulated activities in those areas. The disposal of groundwater into pre-existing jurisdictional areas does not change their regulatory status. That is, adding water to an existing ephemeral or intermittent draw or wetland does not change whether its a jurisdictional water of the U.S. Be aware that the addition of water may expand those area's limits of jurisdiction. Additionally, creation of new wetland or water environments can result in those areas becoming jurisdictional, but need to be evaluated on a case by case basis. If they are determined to be waters of the U.S., their manipulation or elimination may require authorization.

Regulated Activities

When an individual or entity proposes to undertake a dredge or filling operation in a jurisdictional area (water of the U.S.), some form of authorization is needed, unless exempted. Based on discussions with BLM staff it appears that several activities associated with coal bed methane production will likely result in discharges of dredge and/or fill material in waters of the U.S. These include, but are not limited to, construction of access roads, well pads and associated grading, soil stockpiling, water control features (impoundments, splash pads, etc.), and pipelines. Many of these activities can be authorized by Nationwide Permits, many which do not require formal notification to the Corps for authorization. Be aware that authorization of well pads in playa or other wetland/water areas is unlikely. It is suggested that the EIS address this issue and other potential needs for authorization.

Exempted and Non-regulated Activities

The Clean Water Act allows certain discharge activities to occur in jurisdictional areas without the need for a permit (i.e., they are exempt). These activities can include plowing, seeding, and other normal farming and ranching activities that are part of established, on-going operations. Construction of stockponds as well as maintenance of headgates are other activities that can be considered to be exempt from regulation. However, it is stressed that these exemptions have limits and can be nullified depending on a host of variables. Additionally, these exemptions are not applicable to activities associated with the proposed coal bed methane production project. It is also important to note that disposal of mine water into jurisdictional areas does not need authorization, provided there are no associated discharges of dredge and/or fill material with the action. While adding water, in and of itself, to a wetland or other waters of the U.S. is not a regulated activity by the Corps, such releases may be subject to the State Of Wyoming water quality regulations.

It is stressed that these comments are generic in nature and intended to address a set of potential activities that may occur with methane production activities. Project and site specific conditions will have an effect on determinations of jurisdiction as well as other regulatory requirements such as exemptions and permit type. This office is available to provide regulatory guidance to landowners and industry representatives to ensure compliance with the requirements of the Act. We intend to comment on the draft EIS once it is released.

If you have any questions regarding this matter, please contact Chandler Peter at (307) 772-2300. Be sure to reference file number 199840045.

Sincerely,

Matthew A. Bilodeau

Matthew A. Bilodeau
Program Manager
Wyoming Regulatory Office

Copies furnished:

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APPENDIX B
STANDARD "CONDITIONS OF APPROVAL" FOR APDS

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STANDARD "CONDITIONS OF APPROVAL" FOR APDS

BLM - Buffalo Field Office

Mitigating measures (i.e., stipulations), in the form of "Conditions of Approval", are applied to both APD and Sundry Notice Drilling Plans & Surface Use Plans when: 1) they are not specifically addressed in those plans, and; 2)they are needed to mitigate impacts to resource values identified at the onsite inspection or during review of the plans. The first section identifies standard mitigating measures applicable to development involving only coal bed methane. The second section identifies standard mitigating measures that are pertinent to all federal oil & gas lease development. Not all of the mitigating measures in this second section are applicable to coal bed methane development.

It is important to note that site-specific stipulations also are developed by the BLM authorized officer, as needed, on a case-by-case basis at the onsite inspection to address special, unanticipated issues not addressed by a standard mitigating measure (e.g., erosive soils, steep slopes, special wildlife habitats or other special wildlife mitigation measures, proximity to existing improvements, etc.) These special mitigating measures obviously cannot be listed here. The following are the standard mitigating measures that are always applied (if not already specifically addressed in the plans).

Section 1 - APPLICABLE TO COAL BED METHANE WELL DEVELOPMENT ONLY

1. The operator is committed to **all** mitigation measures and monitoring contained in the **(Depends on area)** EA/EIS.

2. The lessee/operator shall provide a comprehensive ***water management plan*** as part of the Project Plan of Development that addresses how produced water will be handled during the testing and production of well(s). Adequate information should be available to develop this plan before wells are drilled.

   For exploratory wells in areas of unknown, untested production potential, the operator will need a temporary (drilling and testing) water management plan. If the well(s) prove to be productive, the operator will then need to submit a permanent water management plan via a Sundry Notice for BLM approval prior to producing the well(s).

   Requirements for temporary and permanent water management plans are listed separately below:

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Temporary Water Management Plan

Items to be addressed in the Temporary Water Management plan include the following:

- Must include a USGS topographic map (1:24000) (or legible copy) showing the actual discharge points, well locations, access routes, and surface pipeline routes.

- Temporary discharge points must be not be located on hill tops or upland areas. They must be located in existing low-gradient channels (below any active or potentially active head cuts). Or, water can be discharged to existing impoundments of adequate size to store all the test water or designed to pass the discharge water (outlet pipes or reinforced spillways).

- Water energy dissipation measures must be designed and utilized at discharge points and along any unstable downstream sections (minor head cuts, eroding channel sections, etc.).

- Only surface piping will be authorized for temporary discharge, no trenching will be allowed.

- Temporary discharge will be allowed only until the wells have been properly tested to prove production.

- Prior to any discharge of water, a standard water quality analysis (barium, iron, manganese, radium-226, chlorides, sulfates, pH, TDS, TPH, and any other parameters, as required by WDEQ) from each well or from representative wells (completed in each zone of production) must be submitted to BLM.

- Prior to any discharge of water, all applicable permits and authorizations (such as WDEQ, WSEO, or COE) must be obtained.

Permanent Water Management Plan

Items to be addressed in the Permanent Water Management plan include the following:

- Must include a USGS topographic map (1:24000) (or legible copy) showing location of the actual discharge points, wells, access routes, pipeline routes, erosion control and stabilization measures, and impoundments (reservoirs).

- Discharge points must be not be located on hill tops or upland areas. They must be located in existing low-gradient channels (below any active or potentially active head cuts). Cumulative discharge must not exceed the naturally occurring, mean annual peak flow of the receiving channel. Water can be discharged to existing impoundments that are designed (outlet pipes or reinforced spillways) to pass the proposed discharge water, the naturally occurring mean annual flow, and any existing discharge water.

➤ Plan for, and design of, erosion control and stabilization measures must be shown. Any in-channel measures must be designed to accommodate existing and proposed discharges in addition to naturally occurring flow.

➤ Any new impoundments or enhancement of existing structures must be properly permitted with the WSEO and/or the COE and designed with outlet works to pass all "existing, planned, and potential discharge water" in addition to naturally occurring mean annual flow. In addition, the combination of flood storage (the volume of storage above the outlet works and below the spillway) and spillway capacity must be adequate to accommodate a specific design flood as required by the WSEO. The required design depends on the size of the impoundment (25-year, 6-hour storm event, or 100 year, 24-hour storm event). Flood storage alone must be adequate to contain lesser events. If passage of water through the spillway is to be frequent, the spillway must be reinforced and designed for continual flow (no regular flows on earthen spillways). The outlet works must also be designed in such a manner as not to affect any existing downstream water rights.

- The "existing, planned and potential discharge water" can be roughly calculated by determining the watershed area, dividing by the minimum well spacing (currently 40 acres), and multiplying this by the average discharge rate. As is obvious, it is undesirable to put impoundments on the main stem of a large drainage.

➤ Water production rates (for each discharge point) must be disclosed including discharge schedule (initial, intermediate, and final rates and duration) and maximum, mean, and minimum anticipated rates.

➤ A standard water quality analysis (barium, iron, manganese, radium-226, chlorides, sulfates, pH, TDS, TPH, and any other parameters, as required by WDEQ) from each well or from representative wells (completed in each zone of production) must be submitted to BLM.

➤ Prior to any discharge of water all applicable permits and authorizations (such as WDEQ, WSEO, or COE) must be obtained.

➤ A hydrologic watershed analysis, based on field reconnaissance, must be done that includes the following:

- Watershed area
- Average watershed slope
- Existing channel (average slope, width, depth, condition, etc.)
- Calculation of mean annual runoff
- Peak flow analysis (annual, 10, and 25 year return interval at a minimum)
- Destination (i.e. tributary to the Belle Fourche River)

➤ **Description of the existing watershed including:**

- **Existing wells (location, depth, water level, use, condition)**
- **Existing impoundments (location, size, volume, use, condition, description of outlet works and spillway)**
- **Road crossings (crossing type - culvert size, low water crossing, bridge, etc. and condition)**
- **Water related uses (i.e. flood irrigated/sub- irrigated crops, livestock, etc.)**
- **Potential downstream concerns (i.e. channel impoundments, hay meadows, coal mine reclamation or sediment structures, unimproved channel crossings, etc.) and plans to mitigate impacts.**

➤ Monitoring Plans, which must include as a minimum:

- Discharge point(s)- will be monitored on a monthly basis during the first year of operation. Inspectors will note the condition of each discharge point, check for evidence of erosion, and schedule any remedial work if required.
- Dam outlets (spillways and pipes) & culvert outlets- will be checked quarterly, or after major storm events during the first year of operation. Inspectors will note the condition of the discharge point, check for evidence of erosion, and schedule any remedial work if required.
- Erosion stabilization measures (headcuts, etc.)- will be inspected for signs of erosion or structure failure. Inspectors will note condition and schedule any remedial work if required.
- Downstream channel (below the well(s)/project)- will be inspected for signs of accelerated erosion due to the continuous flow of produced water.
- After the first year of operation, inspections will only occur annually, unless specific sites have required remedial action. Inspections also will monitor stream channel crossings, culverts, low water crossings, bridges, etc. within and below the project.

If information is not known and cannot be accurately presented, the permanent water management plan needs to be submitted in a subsequent Sundry Notice once the productive capability of the well has been determined.

3. The operator shall submit a **Sundry Notice** for approval **prior to construction** of new surface disturbing activities on lease (e.g., gas & water pipelines, power lines, metering house, access roads and other facilities).

4. The road will be maintained in an undisturbed, 2-track status, as long as year-round, environmentally-sound access can be achieved. The operator shall be responsible for limiting access of field personnel to times when rutting and other resource impacts don't occur. The operator will be responsible for performing any remediation and/or necessary road upgrading (e.g., elevating, surfacing, culverts, low-water crossings, water-wings, etc.) as directed by the BLM authorized officer, resulting from untimely access. In this case, the operator may be

required to conduct a Class III Cultural Inventory, if not already done, on upgrade areas **prior to work being performed**.

5. After drilling and construction of production facilities, and at time of final abandonment, all disturbed areas (including pipelines and access roads) will be drill seeded with the seed mixture shown below, unless a different seed mix is provided by the surface owner. Rates given are in pounds of Pure Live Seed (PLS) per Acre. The operator will provide copies of the seed tags to the authorized officer, if requested.

Species-Cultivar	lbs PLS/Acre
(determined at the site-specific onsite inspection)	

6. If in the process of air drilling a well there is a need to utilize mud, all circulating fluids will be contained either in a small temporary mud pit or in an above-ground containment tank. The pit or containment tank will be of a large enough capacity to safely contain all expected fluids without danger of overflow. Fluids and cuttings will not be squeezed out of the pit, and the pit will be reclaimed in an expedient manner per the above requirements.

7. Vegetation control by mowing or cutting is authorized on the access road and around the well and production facilities to minimize fire hazard and allow safe, environmentally-sound, year-round access. No vegetation or soil blading is authorized.

8. CBM well APDs will not be approved unless the operator provides certification that a water well agreement has been offered as explained in number (12) of the Surface Use Plan.

9. An APD is not considered complete until a Class III cultural resource survey has been performed and a report is submitted to BLM. BLM's consultation with the State Historic Preservation Office is mandatory and can take up to 30 days.

Section 2 - PERTINENT TO ALL OIL & GAS WELL DEVELOPMENT

Note: Not all of the mitigating measures in this section are applicable to coal bed methane development.

DURING CONSTRUCTION

1. Remove all available topsoil (estimated average depth of _____ inches, **determined site-specifically during the onsite inspection**) from the location, including areas of cut, fill, and/or spoil storage areas, and stockpile at the site. Clearly segregate topsoil from excess spoil material. Any topsoil stockpiled for one year or longer will be signed and stabilized with vegetation. Seed with annual ryegrass or other suitable cover crop.

2. The operator will not push soil material and overburden over side slopes or into drainages. All soil material disturbed will be placed in an area where it can be retrieved and where it doesn't impede watershed and drainage flows.

3. Construct the backslope no steeper than 1.5:1. Construct the foreslope no steeper than 2:1.

4. Maintain a minimum 20' undisturbed vegetative border between the toe of fill of pad and/or pit areas and the edge of adjacent drainages.

5. Prior to beginning construction or drilling operations, the operator shall upgrade the proposed access road to BLM standards (including topsoiling, crowning, ditching, drainage culverts, surfacing, etc.) to ensure safe, environmentally-sound, year-round access.

6. A flare pit will be constructed on the well pad for use during drilling operations. It will be located at least 125-feet from the well head and will be located down-wind from the prevailing winds.

7. The reserve pit will be oriented to prevent collection of surface runoff. After the drilling rig is removed, the operator may need to construct a trench on the uphill side of the reserve pit to divert surface drainage around it. If constructed, the trench will be left intact until the pit is closed.

8. The reserve pit will be lined with an impermeable liner if permeable subsurface material is encountered. An impermeable liner is any liner having a permeability less than 10^{7} cm/sec. The liner will be installed so that it will not leak and will be chemically compatible with all substances which may be put in the pit. Liners made of any man-made synthetic material will be of sufficient strength and thickness to withstand normal installation and pit use.

9. If any cultural values (sites, artifacts, remains) are observed during operation of this lease/permit/right-of-way, they will be left intact and the Buffalo Field Manager notified. The authorized officer will conduct an evaluation of the cultural values to establish appropriate mitigation, salvage or treatment.

10. If paleontological resources, either large and conspicuous, and/or a significant scientific value are discovered during construction, the find will be reported to the authorized officer immediately. Construction will be suspended within 250 feet of said find. An evaluation of the paleontological discovery will be made by a BLM-approved professional paleontologist within five (5) working days, weather permitting, to determine the appropriate action(s) needed to prevent the potential loss of any significant paleontological values. Operations within 250 feet of such a discovery will not be resumed until written authorization to proceed is issued by the authorized officer. The applicant will bear the cost of any required paleontological appraisals, surface collection of fossils, or salvage of any large conspicuous fossils of significant scientific interest discovered during the operation.

DURING OPERATIONS

1. Confine all equipment and vehicles to the access road, pad, and area specified in the APD.

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2. All trash will be contained in a trash cage. Upon completion of the drilling operation, the trash cage will be removed and the trash disposed of at an authorized disposal site. No trash or empty barrels will be placed in the reserve pit or buried on location.

3. Fence the reserve pit on three (3) sides during drilling and on the fourth side at the time the rig is removed.

4. Sewage shall be placed in a self-contained, chemically treated porta-potty on location.

5. Rat and mouse holes shall be filled and compacted, from the bottom to the top, immediately upon release of the drilling rig from the location.

6. Produced hydrocarbons shall be put in test tanks on location during completion work. Produced water will be put in the reserve pit during completion work, per Onshore Order #7.

7. Cuttings and drilling fluids shall be put in the reserve pit during drilling.

8. The operator and their contractors shall ensure that all use, production, storage, transport and disposal of hazardous and extremely hazardous materials associated with the drilling, completion and production of this well will be in accordance with all applicable existing or hereafter promulgated federal, state and local government rules, regulations and guidelines. All project-related activities involving hazardous materials will be conducted in a manner that minimizes potential environmental impacts. A file will be maintained containing current Material Safety Data Sheets (MSDS) for all chemicals, compounds and/or substances which are used in the course of construction, drilling, completion and production operations.

9. The only fluids/waste materials which are authorized to go into the reserve pit are RCRA-exempt oil and gas exploration and production wastes. Any evidence of non-exempt wastes being put into the reserve pit may result in the BLM authorized officer requiring specific testing and closure requirements.

   RCRA-exempt oil and gas exploration and production wastes include:

   - drilling muds & cuttings
   - rigwash
   - excess cement and certain completion or stimulation fluids defined by EPA as exempt

   It does not include drilling rig waste, such as:

   - spent hydraulic fluids
   - used engine oil
   - used oil filter
   - empty cement, drilling mud, or other product sacks
   - empty paint, pipe dope, chemical or other product containers
   - excess chemicals or chemical rinsate

IF THE WELL IS A DRY HOLE

1. During reclamation of the site, the operator will push fill material back into the cuts and up over the backslope to approximate the original topography. No depressions will be left that trap water or form ponds.

2. The fluids and mud must be dry in the reserve pit before the pit area is recontoured. The operator will be responsible for recontouring any subsidence areas that develop as a result of closing a pit before it is completely dry. The plastic pit liner will be cut off below grade and properly disposed of before beginning to recontour the site.

3. Before the location has been reshaped and prior to redistributing the topsoil, the operator will rip or scarify the drilling platform and access road, on the contour, to a depth of at least 12 inches. The rippers are to be no farther than 24 inches apart.

4. Distribute the topsoil evenly over the entire location and prepare the seedbed by discing to a depth of 4-to-6 inches, following the contour.

5. Water bars are to be constructed at least one (1) foot deep, on the contour, with approximately two (2) feet of drop per 100 feet of water bar, to ensure drainage. Water bars are to be extended into established vegetation. All water bars are to be constructed with the berm on the downhill side of the water bar, to prevent soft material from silting in the trench. The initial water bars should be constructed at the top of the backslope. Subsequent water bars should follow the following general spacing guidelines:

% Slope	Spacing Interval (feet)
2 or <	200
2 - 4	100
4 - 5	75
5 or >	50

6. The operator will drill seed on the contour to a depth of 0.5 inch, followed by cultipaction to compact the seedbed and prevent soil and seed losses. To maintain quality and purity, certified seed with a minimum germination rate of 80% and a minimum purity of 90% will be used. When a different seed mix desired by the surface owner is not provided, use the following:

Species-Cultivar	lbs PLS/Acre
(determined at the site-specific onsite inspection)	

7. If slopes too steep for machinery to operate, twice the specified amount of seed may be broadcast and raked by hand.

8. Complete fall seeding after September 15 and prior to ground frost. To be effective, complete spring seeding after the frost has left the ground and prior to May 15.

9. The operator will control noxious weeds on the location and along the access road. On BLM-administered surface, this will require authorization in a pesticide use permit.

10. The operator will reshape abandoned access roads by pushing fill material back into the cuts. On roads to be permanently closed, water bars shall be constructed near the contour across the shaped road, utilizing the spacing guidelines contained in No. 5 above.

11. Disc and seed the access road as per No. 6 above.

12. All rehabilitation work, including seeding, will be completed as soon as feasible following plugging.

13. Following seeding, the location will be temporarily fenced off (**if not already fenced**) for at least two complete growing seasons, to ensure long-term reclamation success, unless otherwise requested by the surface owner.

14. BLM will not release the performance bond until the area has been successfully revegetated (evaluation will be made after the second growing season) and has met all other reclamation goals of the surface owner and surface management agency.

15. A Notice of Intent to Abandon and a Subsequent Report of Abandonment must be submitted for abandonment approval.

IF THE WELL IS A PRODUCER

1. The entire location will be fenced off with a 4-strand barbed wire fence, containing H-braces on the corners and a cattleguard, located far enough outside disturbed areas and soil stockpiles to allow for perimeter rehabilitation within the fenced location, unless otherwise requested by the surface owner.

2. Landscape those areas not required for production to the surrounding topography as soon as possible. The fluids and mud must be dry in the reserve pit before recontouring the pit area. The operator will be responsible for recontouring any subsidence areas that develop as a result of closing a pit before it is completely dry.

3. Reduce the backslope to 2½:1 and the foreslope to 3:1. Reduce slopes by pulling fill material up from foreslope into the base of cut slopes.

4. Production facilities (including dikes) must be placed on the cut portion of the location and a minimum of 15 feet from the base of the back cut.

5. A dike will be constructed completely around the production facilities (i.e. production tanks, water tanks, and heater-treater). The dikes for the production facilities must be constructed of **impermeable** soil, able to hold the capacity of the largest tank plus 2-feet of freeboard, and be independent of the back cut.

6. Any chemicals used in treating the wells (e.g., corrosion inhibitor, emulsion breaker, etc.) will be held in a secure, fenced-in area that has a secondary containment structure (dikes, catchment pan, etc.)

7. The load-out line coming from the oil/condensate tank(s) will have a suitable containment structure to capture and recycle any oil spillage that might occur.

8. Individual production facilities (tanks, treaters, etc.) will be fenced-off **(if entire facility not already fenced-off).**

9. Distribute conserved topsoil (from stockpile) evenly over those areas not required for production and seed as recommended. **Due to fragile soils, the entire well location may need to be fenced-off to ensure revegetation success and the stability of the reclaimed location perimeter throughout the producing life of the well, subject to the discretion of the BLM authorized officer.**

10. All permanent above-the-ground structures, tank batteries, etc., that will remain longer than six months will be painted desert brown (Munsell standard color No.______________, **to be determined at onsite**). An exception will be made where special safety colors are required under Wyoming Occupation Health and Safety Act Rules and Regulations.

11. Upgrade and maintain access roads and drainage control (e.g., culverts, drainage dips, ditching, crowning, surfacing, etc.), as necessary, and as directed by the BLM authorized officer, to prevent soil erosion and accommodate safe, year-round traffic.

12. Prior to construction of production facilities not specifically addressed in the APD, the operator shall submit a Sundry Notice to the BLM authorized officer for approval.

13. If not already required prior to constructing and drilling the well location, the operator shall immediately upgrade the entire access road to BLM standards (including topsoiling, crowning, ditching, drainage culverts, surfacing, etc.) to ensure safe, environmentally-sound, year-round access.

PIPELINES AND FLOWLINES

1. Prior to construction, any pipelines/flowlines located off the disturbed well pad must be authorized by the BLM under a Sundry Notice.

2. Graders shall be used whenever possible to construct or to clear the pipeline right-of-way. The cleared right-of-way shall not be more than fifteen (15) feet wide (preferably three (3) feet wide on the soil stockpile side, and twelve (12) feet wide on the working side of the trench) without prior approval of the authorized officer. Bladed materials shall be placed back into the cleared route once construction is completed.

3. Pipeline construction shall not block nor change the natural course of any drainage. Suspended pipelines shall provide adequate clearance for maximum runoff.

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4. Pipeline trenches shall be compacted during backfilling. Pipeline trenches shall be maintained in order to correct settlement and erosion.

5. Water bars are to be constructed at least one (1) foot deep, on the contour, with approximately two (2) feet of drop per 100 feet of water bar, to ensure drainage. Water bars are to be extended into established vegetation. All water bars are to be constructed with the berm on the downhill side of the water bar, to prevent soft material from silting in the trench. The initial water bars should be constructed at the top of the backslope.

   Subsequent water bars should follow the following general spacing guidelines:

% Slope	Spacing Interval (feet)
2 or <	200
2 - 4	100
4 - 5	75
5 or >	50

6. All disturbed areas associated with well drilling and associated facilities (pipelines, access roads, etc.) will be seeded during the first fall following construction. The operator will drill seed on the contour to a depth of 0.5 inch, followed by cultipaction to compact the seedbed, and prevent soil and seed losses. To maintain quality and purity, certified seed with a minimum germination rate of 80% and a minimum purity of 90% will be used. When a different seed mix desired by the landowner is not provided, use the following:

Species-Cultivar	lbs PLS/Acre
(determined at the site-specific onsite inspection)	

7. If slopes are too steep for machinery to operate, twice the specified amount of seed may be broadcast and raked by hand.

8. Complete fall seeding after September 15 and prior to ground frost. To be effective, complete spring seeding after the frost has left the ground and prior to May 15.

9. The operator will be responsible for control of noxious weeds along the pipeline right-of-way. On BLM-administered surface, this will require an authorized pesticide use permit prior to spraying of any commercial herbicides.

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APPENDIX C

SUPPLEMENTAL STANDARD "CONDITIONS OF APPROVAL" FOR APDS

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1. The operator shall utilize wheel trenchers or ditch witches to construct all pipeline trenches associated with this project, except where extreme topography or other environmental factors preclude their use.

2. A pre-construction field meeting shall be conducted prior to beginning any dirt work approved under this POD. The operator shall contact the BLM Authorized Officer (responsible NRS @ (307)684-1100) at least 4-days prior to beginning operations so that the meeting can be scheduled. The operator is responsible for having all contractors present (dirt contractors, drilling contractor, pipeline contractor, project oversight personnel, etc.) including the overall field operations superintendent, and for providing all contractors copies of the approved POD, project map and BLM *Conditions of Approval* pertinent to the work that each will be doing.

3. With the overall objective of minimizing surface disturbance and retaining land stability & productivity, the operator shall utilize equipment that is appropriate to the scope and scale of work being done for roads and well pads (utilize equipment no larger than needed for the job.)

4. All overhead power lines will be built to protect raptors from accidental electrocution.

5. Pit will be **adequately** fenced during and after drilling operations until pit is reclaimed so as to effectively keep out wildlife and livestock. **Adequate fencing**, in lieu of more stringent requirements by the surface owner, is defined as follows:

   - Construction materials will consist of steel or wood posts. Three or four strand wire (smooth or barbed) fence or hog panel (16-foot length by 50-inch height) or plastic snow fence must be used with connectors such as fence staples, quick-connect clips, hog rings, hose clamps, twisted wire, etc. Electric fences will not be allowed.

   - Construction standards: Posts shall be firmly set in ground. If wire used must be taut and evenly spaced, from ground level to top wire, to effectively keep out animals. Hog panels must be tied securely into posts and one another using fence staples, clamps, etc. Plastic snow fencing must be taut and sturdy. Fence must be at least 2-feet from edge of pit. 3 sides fenced before beginning drilling, the fourth side fenced immediately upon completion of drilling and prior to rig release. Fence must be left up and maintained in adequate condition until pit is closed

6. Pits will be closed as soon as possible, but no later than 90 days from time of drilling/well completion, unless an extension is given by the BLM Authorized Officer

7. The operate shall complete wells as soon as possible, but no later than 30 days after drilling operations, unless an extension is given by the BLM Authorized Officer

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APPENDIX D
BIOLOGICAL ASSESSMENT

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Biological Assessment

WYODAK COAL BED METHANE DRAINAGE PROJECT

Prepared for

U.S. Department of Interior
Bureau of Land Management

December 2000

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WYODAK COAL BED METHANE DRAINAGE PROJECT
BIOLOGICAL ASSESSMENT

INTRODUCTION

The purpose of this Biological Assessment (BA) is to review the Proposed Action of the Wyodak Coal Bed Methane Drainage Project in sufficient detail to determine if the action "may affect" any federally listed threatened, endangered, or proposed species. This BA was prepared in accordance with the legal requirements set forth under Section 7 (c) of the Endangered Species Act, as amended (16 U.S.C. 1536).

CONSULTATION TO DATE

In a letter dated November 20, 2000, providing comments on the Draft Environmental Assessment (EA) for the Wyodak Coal Bed Methane Drainage Project, the U.S. Fish and Wildlife Service (USFWS) identified the following threatened, endangered, or proposed species that may be present in the project area: bald eagle (*Haliaeetus leucocephalus*), black-footed ferret (*Mustela nigripes*), mountain plover (*Charadrius montanus*), and Ute ladies'-tresses (*Spiranthes diluvialis*).

DESCRIPTION OF THE PROPOSED PROJECT

The Wyodak Coal Bed Methane Drainage Project is located in Campbell and Converse counties, Wyoming, within the Powder River Basin (**Figure 1**). The proposed action incorporates additional wells to the existing Wyodak Coal Bed Methane Project, as analyzed in the Wyodak Coal Bed Methane Project Final Environmental Impact Statement (Bureau of Land Management (BLM) 1999a). The entire Wyodak project area covers 2,317,000 acres. Surface ownership within the project area is primarily private (about 92 percent), while approximately 50 percent of the oil and gas rights are federally owned.

The proposed action will allow for the drilling, completion, operation, and reclamation of 2,500 coal bed methane wells on lands with federally-owned oil and gas mineral rights, and construction of associated facilities, including access roads, gas gathering and water disposal pipelines, and electrical utilities. Exact location of these facilities will be determined during the BLM's Application for Permit to Drill (APD) process. Development is expected to occur at a maximum density of 8 wells per square mile (1 well per 80 acres). At project completion there will be an average well density of 0.7 wells per square mile over the entire project area.

Produced water will be piped away from the well sites and discharged into existing drainages at established discharge points. Water produced by the proposed action, along with water produced from existing wells, will result in the discharge of approximately 83,329 acre-feet of water per year. The exact locations of discharge points, and the volume of water produced from each discharge point and within each watershed, will be determined during the APD process.

The total disturbance for the proposed action would be 17,251 acres, or approximately 0.7 percent of the project area. Development of the proposed action will result in potential short-term disturbance of

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approximately 7,770 acres. Short-term disturbance includes approximately 0.62 acres per well of ground disturbance during the installation of gas pipelines, below-ground electric lines, and water discharge pipelines. A limited number of newly-constructed overhead electric distribution lines are anticipated; existing above-ground distribution lines will also be used. Overhead electric lines will utilize raptor protection measures (Avian Power Line Interaction Committee (APLIC) 1994, APLIC 1996). All areas subject to short-term disturbance will be reclaimed following drilling or installation of facilities. Reclamation will occur within no more than 3 years of initial disturbance. Implementation of the proposed action will result in potential long term disturbance of 9,501 acres (0.76 acres per well). Long-term disturbances include approximately 0.30 acres per well for improved roads, 0.33 acres per well for two-track access roads, and 0.13 acres per well for the well sites and central gathering and metering facilities. Areas subject to long-term impacts will be reclaimed at the end of the life of the project.

BALD EAGLE

Existing Environment

The bald eagle is a federally-listed threatened species. The bald eagle was proposed for de-listing on July 6, 1999 (USFWS 1999a). Currently the proposal has not been finalized or withdrawn by the USFWS. Bald eagles prefer nesting in large trees near water. Nest sites are usually in large trees along shorelines in relatively remote areas that are free of disturbance (USFWS 1999a). There is a relatively low concentration of large trees in close proximity to riparian areas in the proposed project area. One historically active bald eagle nest has been documented in the project area on Wild Horse Creek (USFWS 2000). Since the nest has not been occupied since 1991, nesting is not likely to be affected within the area (USFWS 2000).

The survival and recovery of nesting populations is partially dependent on the eagles having suitable locations to use throughout the wintering period each year (USFWS 1983). Wintering bald eagles primarily occur where feeding areas and night roosts are in close proximity, although they will fly up to 15 miles where these elements are sparsely distributed across the landscape (Swisher 1964), as in this part of Wyoming. Food availability is probably the single most important factor affecting winter bald eagle distribution and abundance (Steenhof 1976). Fish and waterfowl are the primary sources of food where eagles occur along rivers and lakes. Big game and livestock carrion, as well as larger rodents (e.g., prairie dogs) also can be important dietary components where these resources are available.

Roosts are used for sleeping and as protection from winter storms. Eagles typically leave the roost in the early morning and return in the evening, though they may remain at the roost all day during severe weather. Roosts are commonly located in riparian habitats although eagles will also use timbered upland areas if they are available. Open canopy trees are used as roosts during the day and on warm nights (when dawn and dusk temperatures exceed 20°F). Closed canopy or protected trees are used as roosts on cold nights (when dawn and/or dusk temperatures are below 20°F) (Colorado Division of Wildlife 1996).

The presence of six bald eagle winter roosts has been documented within the project area. The presence of an additional six winter roosts has been documented within a 10-mile radius of the project area (BLM

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1998b). Sightings of bald eagles are common during winter months in the project area. Due to the large proportion of private land within the project area, additional winter roost sites are expected to occur.

Effects of the Proposed Project

Bald eagles foraging or roosting within the project area may be affected by the proposed project and associated human disturbance. A small proportion of potential foraging habitat may be lost as a result of the proposed project, but the availability of prey is not expected to be substantially altered. Various short-term activities associated with the proposed project may slightly alter foraging patterns as eagles fly around activity areas, but the large amount of area that will not be affected at any particular time should serve to minimize any disturbance to foraging individuals. Mitigation measures to protect bald eagles, as discussed below, will be applied during the APD approval process, minimizing impacts to roosting and nesting individuals.

The proposed project will result in the construction of new roads and an ensuing increase of traffic. As big game make use of the project area, there may be an increase in big game mortality due to vehicular collisions. The availability of these road-killed carcasses may increase foraging by bald eagles in the project area, thereby increasing the potential for vehicular collisions to cause bald eagle mortality.

Power lines have the potential to cause two different types of impacts to avian species, including bald eagles: collision and electrocution. The potential for collision is not considered substantial for adult bald eagles due to their high degree of visual acuity and generally slow, deliberate flight (APLIC 1994). Electrocution can occur when birds with long wing spans come into contact with two conductors, a conductor and a ground, or a conductor and the tower structure while landing, stretching, or taking off. The potential for electrocution is greatest for large raptors, such as eagles, that use power poles as perch sites. Most electrocutions occur on lower voltage distribution lines operated between 1kV and 69kV (APLIC 1996).

The potential for adult bald eagles to collide with, or be electrocuted by, distribution lines associated with this project is minimal due to the use of raptor protection measures (APLIC 1994, APLIC 1996) on all newly-constructed distribution lines. Immature bald eagles are expected to winter in the project area. The potential for immature bald eagles to collide with, or be electrocuted by, distribution lines associated with this project is also expected to be minimal. Immature bald eagles will have migrated a substantial distance prior to arriving at the project area. Most will have crossed numerous distribution lines in the course of this migration, and will have gained experience with both flight itself and with transmission lines.

Determination

Implementation of the proposed action as described above may affect, but is not likely to adversely affect, the bald eagle or its habitat. This determination is based on the discountable effects of the proposed project on this species as discussed above, and on implementation of the mitigative measures as outlined below.

Mitigation Measures

The following mitigation measures are designed to minimize the potential effects of the proposed action on the bald eagle.

1. Surveys for active raptor nests (including bald eagle nests) will be conducted prior to the commencement of construction activities. Appropriate times and locations for these surveys will be determined in consultation with the land-managing agency.

2. The appropriate standard seasonal or year-long stipulations for raptors (including wintering bald eagles), as identified by the BLM's Resource Management Plan (BLM 1985), will be applied. A minimum disturbance-free buffer zone of one-half mile will be established for all bald eagle nests and roost sites. Adjustments for timing and enlarged buffer zones may be established based on site specific information, as appropriate, at the APD level of analysis.

3. Speed limits on all access roads associated with project activities shall not exceed 35 mph to minimize the chance of a vehicular collision with a bald eagle or other wildlife.

4. All power lines will be built using raptor protection measures to protect raptors (including bald eagles) from accidental collision (APLIC 1994) or electrocution (APLIC 1996).

5. Power line corridors will avoid wetlands, to the extent possible, in order to reduce the chance of waterfowl hitting the lines.

BLACK-FOOTED FERRET

Existing Environment

The black-footed ferret is a federally-listed endangered species. Black-footed ferrets are nocturnal animals that are nearly always associated with prairie dog colonies. Prairie dogs form large colonies in short-grass and mixed-grass prairies. Prairie dogs are the main prey source for the black-footed ferret. Prairie dog burrows provide dens and rearing areas for ferret offspring. Ferrets may occur within colonies of white-tailed or black-tailed prairie dogs. The project area is within the range of both the black-tailed and white-tailed prairie dog.

The USFWS has determined that, as a minimum, potential habitat for the black-footed ferret must include a single black-tailed prairie dog colony of greater than 80 acres or a single white-tailed prairie dog colony of greater than 200 acres. Alternately, a complex of smaller colonies within a 4.3 mile (7-km) radius circle totaling 80 acres for black-tailed prairie dogs, or 200 acres for white-tailed prairie dogs would also provide the minimum requirements for potential habitat for the black-footed ferret (USFWS 1989).

The project area is within the historical range of the black-footed ferret, although no black-footed ferrets are presently known to occur in northeastern Wyoming. Six large prairie dog colonies have been identified within the project area (BLM 1999c). Additional colonies are expected to occur, particularly on private lands, due to the large amount of short-grass and mixed-grass prairie within the project area.

Effects of the Proposed Project

No impacts to the black-footed ferret are expected because all prairie dog colonies of sufficient size to support black-footed ferrets will be surveyed prior to any ground-disturbing activities. If any ferrets are located, consultation with USFWS will be completed prior to any ground-disturbing activities, and the BA will be amended to reflect the results of consultation. No disturbance will be allowed within any prairie dog colonies found to be inhabited by black-footed ferrets.

Determination

Implementation of the proposed project as described above may affect, but is not likely to adversely affect, the black-footed ferret or its habitat, based on discountable effects. This determination is based on the lack of known black-footed ferret colonies in the project area and on implementation of mitigation measures as outlined below.

Mitigation Measures

The following mitigation measures are designed to minimize the potential effects of the proposed action on the black-footed ferret.

1. Prairie dog towns will be surveyed for the presence or absence of black-footed ferrets if the towns meet the Black-footed Ferret Guidelines (USFWS 1989). When surveys are required, the entire town affected by the proposed project will be surveyed. These surveys are required even if part of the town has a burrow density below eight per acre. If any black-footed ferrets are located, the USFWS will be consulted and additional mitigation may be required.

2. Disturbance in prairie dog towns not inhabited by black-footed ferrets will be avoided where ever possible, to protect the prairie dogs themselves as well as sensitive species such as the burrowing owl.

MOUNTAIN PLOVER

Existing Environment

The mountain plover was proposed for listing as threatened on February 16, 1999 (USFWS 1999b). A final listing rule on this species is pending. The mountain plover is a small bird similar in size to the killdeer (*Charadrius vociferus*), that breeds on high, dry, short-grass prairies. They are found associated with plains, alkali flats, agricultural lands, cultivated lands, and prairie dog towns. Within this habitat, areas of blue grama (*Bouteloua gracilis*) and buffalo grass (*Buchloe dactyloides*) are most often utilized, as well as areas of mixed grass associations dominated by needle-and-thread (*Stipa comata*) and blue grama (Dinsmore 1983).

Short vegetation, flat topography and bare ground are the common characteristics of mountain plover nesting habitat. Nests consist of a small scrape placed on slopes of less than 5 degrees in areas where vegetation is less than 3 inches tall in April. More than half of identified nests occurred within 12 inches of old cow manure piles and almost 20 percent were found against old manure piles in similar habitats in Colorado. Nests found in similar habitats in Montana (Dinsmore 1983) and other areas (Ehrlich et al. 1988) were often associated with the heavily grazed short-grass vegetation of prairie dog colonies. Plovers begin laying eggs in late April. Clutches hatch by late June and chicks fledge by late July.

Potentially suitable nesting habitats for the mountain plover occur throughout the entire project area. A number of mountain plover sightings have been recorded in the southeast corner of the project area (BLM 1998b). Mountain plovers are expected to occur in the rest of the project area as well, although sightings have not been recorded due to the low population density, large amount of private land, and lack of survey efforts. Prairie dog towns are scattered throughout the project area, particularly in the southeastern and northwestern portions of the project area. Livestock grazing is the primary land use, also contributing to the development of potential mountain plover habitats in the project area by producing heavily grazed short-grass prairie conditions.

Effects of the Proposed Project

Disturbance impacts from well drilling and facility construction are expected to be short-term. Mitigation measures outlined below require that surveys be conducted prior to ground-disturbing activities, and that all mountain plover nesting areas be avoided until after the breeding season, thus minimizing the potential for construction related disturbance impacts. Foraging or migrating individuals may be displaced by construction related activities.

In addition to short-term disturbance, there are likely to be long-term disturbance impacts related to maintenance of production facilities, and to noise produced by these facilities. Noise and activities around these facilities will likely prevent mountain plovers from nesting, and perhaps foraging, within a certain distance of compressor stations and other facilities. The extent to which these disturbances will affect the mountain plover is unknown and depends on the frequency of maintenance activities, the amount of noise produced by the different types of facilities, and the ability of mountain plovers to become accustomed to both consistent noise and sporadically-occurring maintenance activities.

Potential mountain plover habitat will be affected by the proposed project. Much of the project area is covered with vegetation that may provide nesting and foraging habitat. As stated in the project description above, approximately 9,501 acres will be disturbed in the long-term. This area will be lost as potential habitat for the mountain plover. The extent to which this habitat is currently used by plovers is unknown, because the exact locations of the long-term disturbance areas are not known, and because patterns of habitat use by mountain plovers in the project area are not known. As stated above, long-term disturbance will likely render additional habitat adjacent to facilities unsuitable.

Approximately 7,750 acres will be disturbed in the short-term. Following reclamation, this area will again be available as potential habitat to the mountain plover. The increase in disturbed and bare ground that will result from construction activities may potentially increase the amount of mountain plover nesting habitat following the construction phase of the proposed project. The extent to which these habitats are currently used by plovers is unknown, because the exact locations of the short-term disturbance areas are not known, and because patterns of habitat use by mountain plovers in the project area are not known.

An increase in traffic from newly constructed roads may contribute to mountain plover mortality from vehicle collisions. During incubation the plover is fairly sensitive to human disturbance. Flushing distances may be within three meters for vehicles, but plovers may be displaced from the nest by a human on foot at a much greater distance (USFWS 1999c). Because vehicles can approach within close proximity without flushing the plover, direct losses of eggs, chicks, and adults may occur through vehicle collisions. Human disturbance may cause loss of eggs or chicks if attending mountain plover adults are displaced long enough to expose the eggs or chicks to excessive heating, chilling, or predation. Permanent structures that provide perch or nest sites for avian predators or den sites for terrestrial predators may indirectly increase the incidence of predation on mountain plovers.

Human activity associated with project development and operation in historically used breeding areas may disturb nesting birds enough to cause them to abandon the breeding area, particularly if disturbance extends over more than one breeding season (USFWS 2000). Frequent disturbance during the breeding season may cause nesting birds to be displaced. If nesting birds are displaced to habitats where nesting success is lower, this would result in a loss of breeding potential. The Mountain Plover Survey Guidelines (USFWS 1999c) recommend a 200-meter buffer for disturbances including pedestrian traffic and continual equipment operations.

Disturbance of prairie dog towns that provide important habitat components for the mountain plover may have negative effects on this species by reducing the amount of heavily grazed short-grass prairie vegetation. Disturbance in prairie dog towns will be avoided where ever possible. Livestock grazing will continue as a primary land use, and will continue to provide manure piles and grazed areas as habitat components. Use of native plant materials in reclamation will help maintain the quality of mountain plover habitat in the project area.

Determination

Implementation of the proposed project as described above **may affect, and is likely to adversely affect**, the mountain plover or its habitat. This determination is based on the effects of the proposed action on this species as discussed above, and on implementation of the mitigation measures as outlined below.

Mitigation Measures

The following mitigation measures are designed to minimize the potential effects of the proposed action on the mountain plover.

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1. Surveys for nesting mountain plovers will be conducted in compliance with the Mountain Plover Survey Guidelines (USFWS 1996a) if ground disturbing activities related to the proposed project are anticipated to occur between April 1 and July 31. No ground disturbing activities will occur in suitable nesting habitat during this period, prior to conducting surveys. A disturbance-free buffer zone of one-quarter mile will be established around all mountain plover nesting locations between April 1 and July 31.

2. Roads will be located, wherever possible, outside of nesting plover habitat. Speed limits shall be posted at 35 mph on local roads and 25 mph within one-half mile of identified nesting areas to minimize the threat of vehicle collision.

3. Creation of hunting perches for avian predators will be minimized within one-half mile of identified nesting areas, by using the lowest possible structures for fences, markers and other structures and by incorporating perch-inhibiting devices into their design.

4. Disturbance in prairie dog towns will be avoided wherever possible, to protect the prairie dogs themselves, sensitive species such as the burrowing owl, and mountain plover habitat.

5. Native seed mixes will be used, where appropriate, in order to re-establish short grass prairie vegetation. Revegetation will maintain requirements for stabilizing soil and controlling weeds. Reclamation in all areas shall attempt, as much as possible, to return the plant community to the pre-existing condition.

UTE LADIES'-TRESSES ORCHID

Existing Environment

The Ute ladies'-tresses orchid is a federally-listed threatened species. Ute ladies'-tresses orchid occurs primarily in seasonally moist soils near wetland meadows, springs, lakes, or perennial streams. The orchid establishes in open grass and forb-dominated sites that are not overly dense or overgrown (Coyner 1989, 1990; Jennings 1989, 1990). Populations occur in mesic or wet meadows near riparian edges, gravel bars, and old oxbows along perennial streams within an elevational range of 4,000 to 7,000 feet. A few populations in eastern Utah and Colorado are found in riparian woodlands, but the orchid seems generally intolerant of shade. Most populations occur as small scattered groups occupying relatively small areas within the riparian system. This orchid may require sub-irrigation at least during the growing season, which in this semi-arid climate dictates a close affinity with floodplains where the water table is near the surface throughout the growing season and into early autumn.

The orchid is well-adapted to disturbances from stream movement and is tolerant of others, such as grazing, that are common to grassland riparian habitats (USFWS 1995). It is known to be established in heavily disturbed sites, such as revegetated gravel pits, heavily grazed riparian edges and along well-traveled foot trails on old berms (USFWS 1995). This perennial orchid has few to many small white or ivory flowers clustered into a spike arrangement at the top of the stem. It blooms from late July through August. Ute ladies'-tresses orchid is commonly associated with horsetail (*Equisetum* spp.), milkweed (*Asclepias* spp.), verbena (*Verbena* spp.), blue-eyed grass (*Sisyrinchium montanum*), reedgrass (*Calamagrostis* spp.), goldenrod (*Solidago* spp.), and arrowgrass (*Triglochin* spp.). Ute ladies'-tresses has an irregular flowering pattern, and the ability to persist below ground for years between periods of flowering. Because it may not flower or emerge every year, additional surveys may be necessary.

Populations occur in three general areas of the interior western United States: the Wasatch Front and west desert of Utah, the Uinta Basin in Utah, and the Front Range of Colorado and Wyoming (USFWS 1992). Ute ladies'-tresses is currently known from 4 sites in eastern Wyoming, including: a small population along a tributary to Antelope Creek (a tributary to the Cheyenne River) in northwest Converse County; a population along Bear Creek in southwestern Goshen County; a population along the Niobrara River near McMaster's Reservoir in southeastern Niobrara County; and, a population along Sprager Creek in Laramie County. These populations are monitored on a limited basis and appear to be stable. Mowing and grazing occur at two of the sites and appear to have only minor impacts on the populations (Fertig 2000).

There are no known occurrences of this species within the project area, although the Antelope Creek occurrence is just to the southwest of the project area (Jennings 1999). This small population occurs on BLM land along a tributary to Antelope Creek just upstream of the project area. The population was discovered in 1994 and remains small. The habitat is considered marginal and the population is the least viable of the populations within Wyoming (Fertig 2000). Smaller areas of potentially suitable habitat are anticipated to occur in scattered locations in the project area, although no large populations are likely to occur.

Effects of the Proposed Project

The proposed project has the potential to impact Ute ladies'-tresses in several ways: through construction-related impacts, placement of proposed facilities within occupied or potential habitats, and through alterations in hydrology that change the suitability of occupied or potential habitats. Wetlands and wet meadow areas will not generally be used for placement of facilities. Mitigation measures require that surveys be conducted if proposed facilities will impact potentially suitable habitats. During APD review, potentially suitable habitats for this species will be located and surveyed before any ground-disturbing activity is permitted. Facility location will be adjusted to avoid impacts if occurrences of Ute ladies'-tresses are discovered.

In areas of Ute ladies'-tresses occurrences, the discharge of water into riparian and wetland areas may impact this species, although the extent of these impacts depends on the relationship between the location of occurrences and the location of discharge points. At present, predictions can only be made of the effects of water discharge on larger stream and river basins. It has been estimated that coal bed methane-related water discharges will increase average annual runoff of the Upper Reach of the Powder River at Arvada, Wyoming by 4.2 percent, of the Middle Reach of the Powder river at Moorhead, Montana by 1.1 percent, of the Little Powder River at Weston, Wyoming by 54 percent, of the Belle Fourche River below Moorcroft, Wyoming by 171 percent, and of the Upper Cheyenne River at Edgemont, South Dakota by 19 percent.

Coal bed methane generated flows occur year-round. Average streamflows are expected to increase. Drainages that are ephemeral may become perennial downstream from the discharge points. Localized erosion and gully formation may result from flood events. In addition to increased in-stream flows, water developments peripheral to coal bed methane development, such as reservoir, stock pond, or wetland construction, may disturb potential Ute ladies'-tresses habitat and/or may alter the hydrology of the potential habitat. Plans for these peripheral developments will be reviewed as part of the APD process. Where these developments will be built in potential Ute ladies'-tresses habitat, surveys for the species will be conducted prior to construction. These developments also have the potential to alter the local hydrology, both upstream and downstream of any water control structures. Potential Ute ladies'-tresses habitat may be affected hydrologically, but may not be surveyed if they occur some distance away from ground disturbing activities.

Vegetation community composition may shift as a result of the discharge of produced water. The produced water may reduce or increase Ute ladies'-tresses habitat depending on amount and timing of the discharge. Discharge of water into stream systems where the plant exists may result in some adverse effects due to erosion and other changes in the stream corridor. If the discharged water only slightly increases the stream flows, existing habitat may be augmented or habitat may be created in areas where it would not have existing naturally. This would result in a beneficial effect to Ute ladies'-tresses.

Flows in some streams may be only moderately or minimally reduced due to impacts to the water table and Ute ladies'-tresses may be unaffected in these cases. Impacts to groundwater could result in significant drying and vegetative changes in some areas. A secondary effect related to the produced water is the potential for an increase in soil salinity resulting from the evaporation of discharge waters. Short and long-term impacts associated with the proposed project may provide an opportunity for the invasion and establishment of noxious weeds. Noxious weeds have the potential to out-compete Ute ladies'-tresses and reduce the viability of populations that they have invaded.

The exact nature of water discharge-related impacts will need to be addressed during APD review, when water discharge points have been chosen, and Ute ladies'-tresses surveys completed. It is possible that occurrences of this species downstream of discharge points will not be identified by surveys, particularly if no facilities are planned in the vicinity. These occurrences could be affected by changes in local hydrology resulting from upstream discharge of produced water. The extent of these impacts cannot be quantified at present, due to the lack of surveys for this species, the lack of precise discharge point locations and the lack of knowledge of the interactions between upstream discharges, existing flows, and local conditions in potential Ute ladies'-tresses habitats.

Determination

Implementation of the proposed action as described above **may affect, and is likely to adversely affect**, the Ute ladies'-tresses orchid or its habitat. This determination is based on the effects of the proposed project on this species as discussed above, and on implementation of the mitigation measures as outlined below.

Mitigation Measures

The following mitigation measures are designed to minimize the potential effects of the proposed action on the Ute ladies'-tresses.

1. Potentially-suitable habitats for Ute ladies'-tresses (i.e., wetlands and associated wet meadow areas) will be surveyed according to USFWS standards (USFWS 1992) if ground-disturbing activities are anticipated within these habitat types. Facility locations will be adjusted to remove any potential for impacts.

2. Moist soils near wetlands, streams, or springs in the project area will be promptly revegetated if construction activities impact the vegetation in these areas. Revegetation methods will be implemented that will prevent the establishment of noxious weeds.

CUMULATIVE EFFECTS

Within the project area, existing impacts to species listed as threatened or endangered, or proposed for listing as threatened or endangered include oil and gas production, surface coal mining, uranium mining, sand and gravel mining, ranching, and existing coal bed methane development. About 12,800 acres that were disturbed for coal mining have since been reclaimed. On-going disturbance from coal mining is expected to be mitigated by reclamation of areas where coal mining has been completed, with equal areas of new disturbance and new reclamation in the near future.

Approximately 55,650 acres (2.4 percent of the project area) of long-term surface disturbance has occurred within the project area as a result of coal bed methane development as of 1997. Approximately 7,000 coal bed methane wells have been drilled as of November 2000, contributing to approximately 4,340 additional acres of long-term disturbance.

Due to increasing interest in the development of coal bed methane, additional areas may be disturbed by future exploratory and production activities. At present it is difficult to determine the potential extent of additional development, although it is expected to occur at a rate faster than closing and reclamation of existing wells over the next five to ten years. Additional development is expected to be of a scale similar to the currently proposed project if not greater. This development is likely to occur within, as well as outside of, the current project area. In the near future (5-10 years), the amount of disturbed habitat is likely to increase, although the anticipated life of coal bed methane wells (12-20 years) indicates that reclamation will eventually overtake new well development, resulting in a net decrease in disturbed habitats over the long-term.

In areas reclaimed after coal mining and oil and gas development, the reclaimed areas often differ substantially from undisturbed areas in terms of topography, soil conditions, hydrology, and vegetation cover. Ecosystem functions presently served by undisturbed vegetation communities may not be served by reclaimed areas, particularly in the short term, when species composition, shrub cover, and other environmental factors will likely be different.

Foraging habitat for bald eagles could be reduced, as preferred prey species may not quickly re-inhabit disturbed areas. Alternately, the expected increase in surface water and wetland areas in some parts of the project area may increase the availability of waterfowl as prey.

Prairie dog colonies that are surveyed and found not to be occupied by black-footed ferrets could be disturbed by the proposed project. Future loss of prairie dog colonies may occur as a result of various activities that are on-going or planned for the project area. Although potentially suitable habitat for the black-footed ferret in the project area may be reduced by the cumulative effects of this project and future activities, no net reduction in the viability of existing ferret populations is expected to occur as a result of this habitat loss.

Some mountain plover habitat may be lost as a result of coalbed methane development, although additional areas may become suitable, due to the preference of mountain plovers for disturbed areas as nesting sites. It is also likely that mountain plover eggs or individuals may be lost due to the increase in human and vehicle traffic. The abundance of available potential habitat in the project area suggests, however, that the losses associated with this project, and future projects of similar nature, will not have any adverse cumulative effects on this species.

Development in wetland and floodplain habitats preferred by the Ute ladies' tresses orchid has generally been avoided within the project area, due to the rare nature of riparian and wetland areas, the abundance of upland areas available for development, and the low level of development in Campbell and Converse counties. The potential for development of these habitats remains low, meaning that only minimal direct impact to potential habitat for this species will occur in the future. Increased coal bed methane development will have the potential to continue altering the hydrology of potential habitat, possibly to the extent that some currently suitable habitat becomes unsuitable. Following closure and reclamation of wells, alteration of surface hydrology will cease, and water regimes in currently suitable habitat will return to existing conditions.

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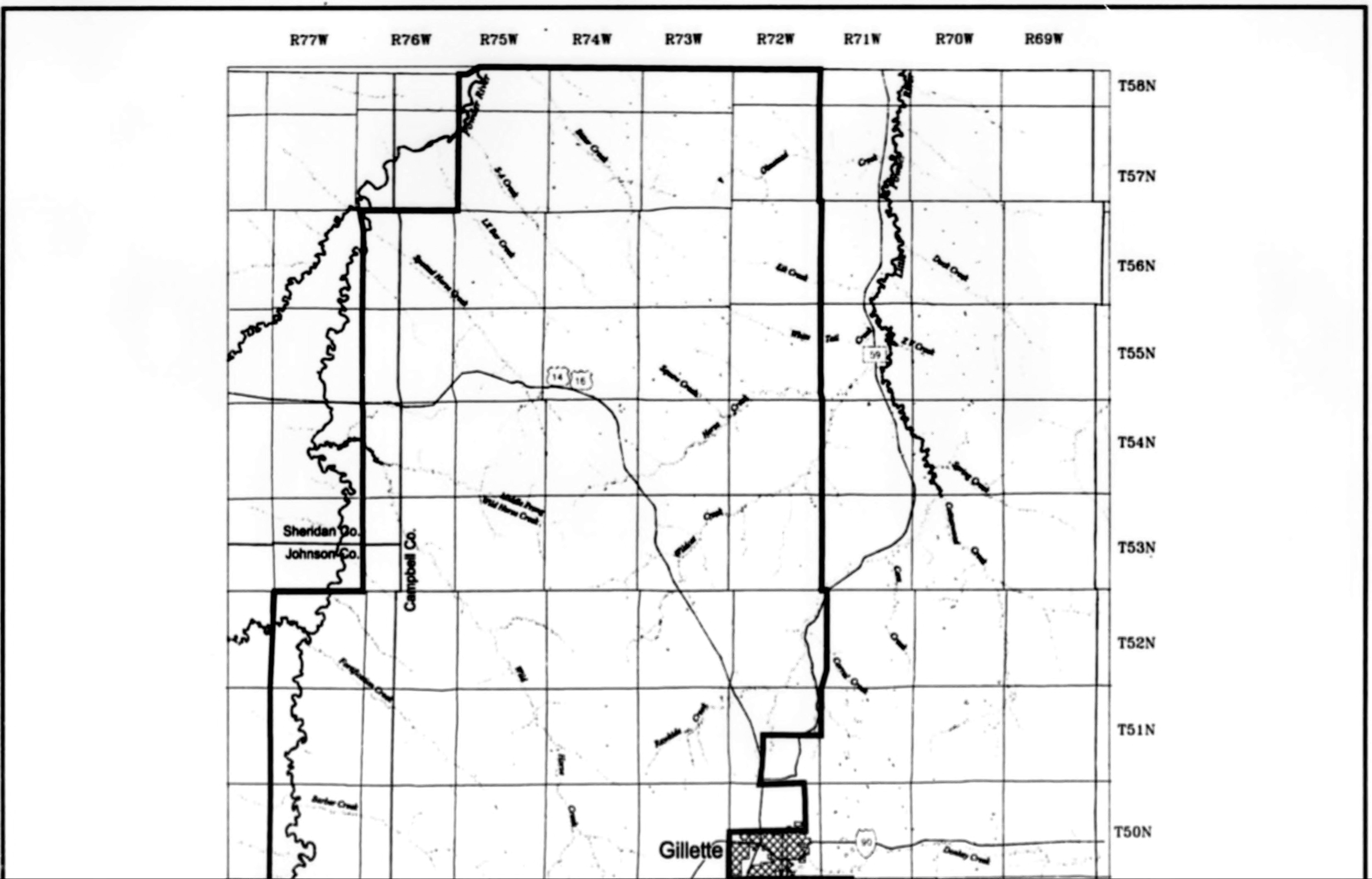
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T51N
T50N
Powder River
Elk Creek
White Tail Creek
Dead Creek
Spring Creek
Spotted Horse Creek
Middle Prong Wild Horse Creek
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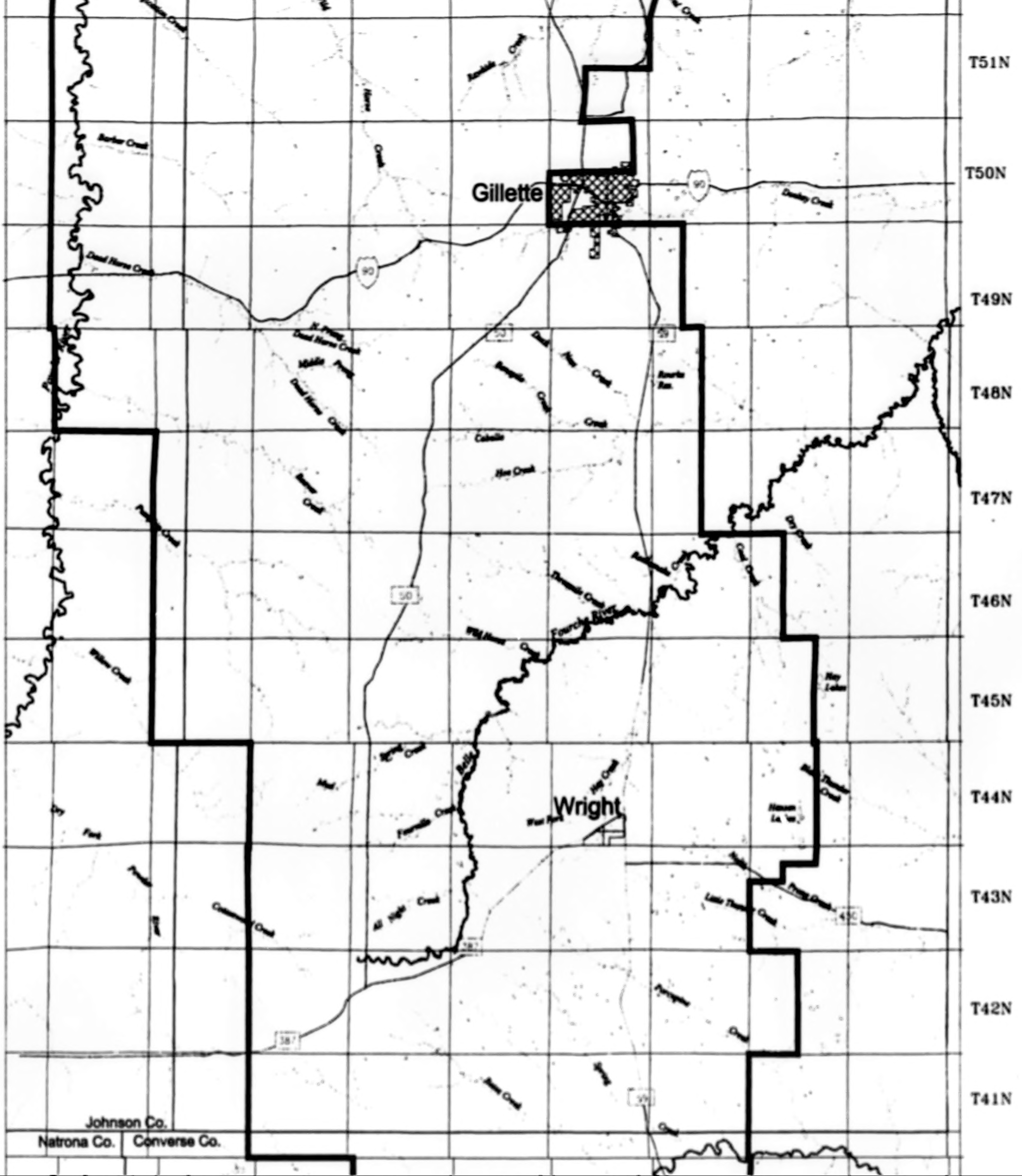
Johnson Co.
Campbell Co.
Rawhide Creek
Barber Creek
Donkey Creek
90
Gillette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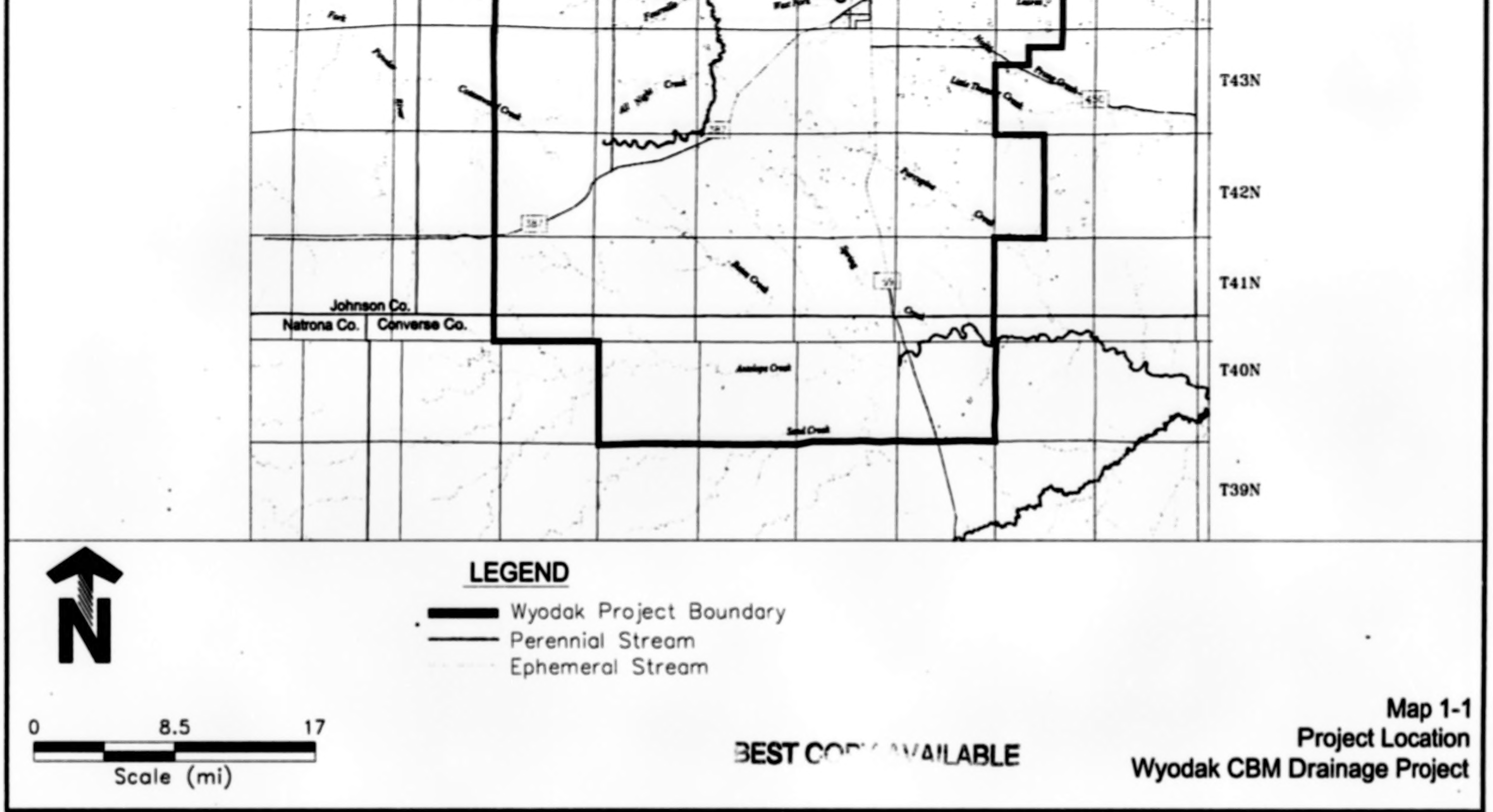
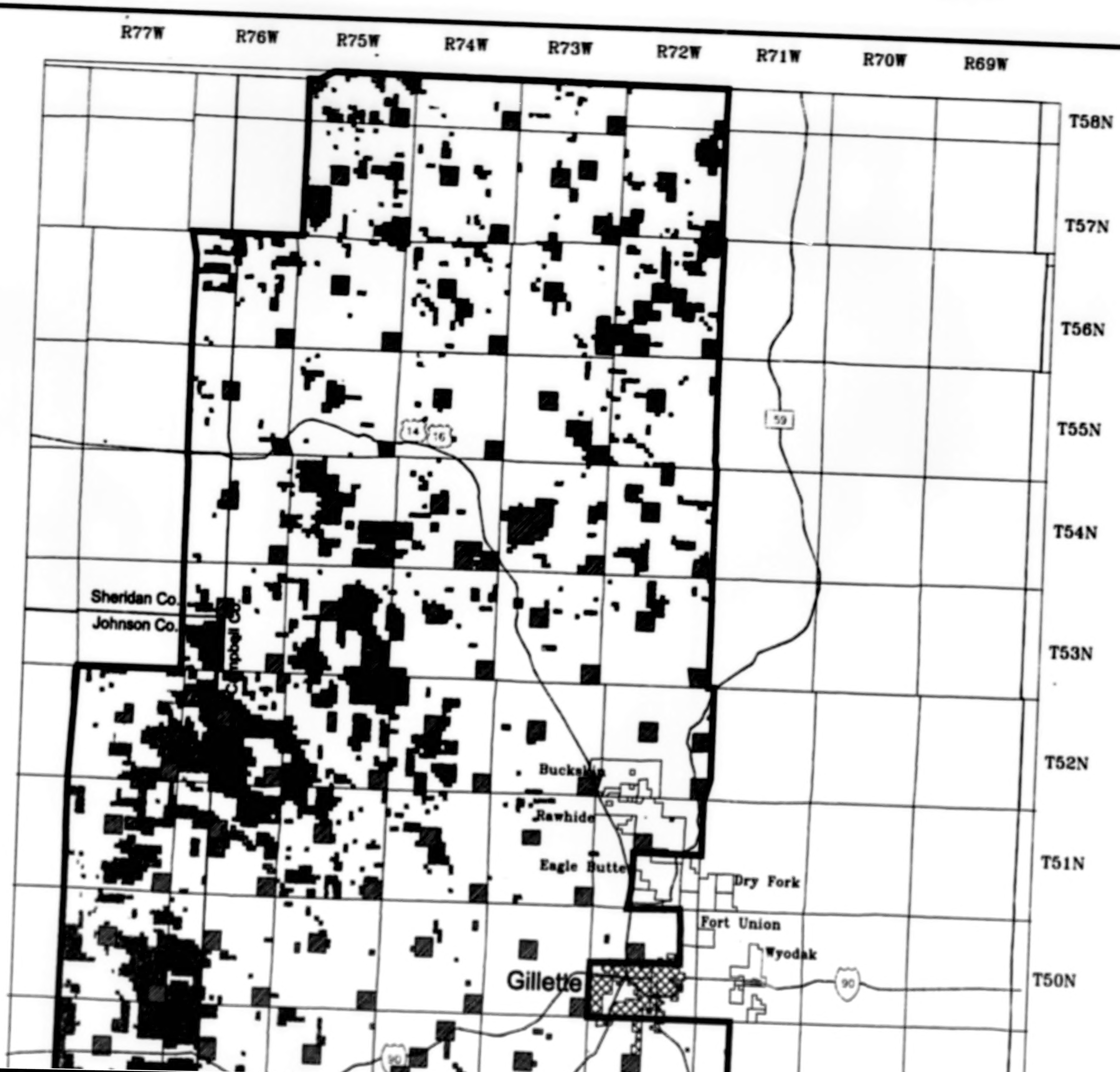
Wright
90
50
59
387
450
Barber Creek
Donkey Creek
Dead Horse Creek
Middle Prong
Caballo
Hay Creek
Wild Horse Creek
Fourche River
Belle
Hay Lakes
All Night Creek
Johnson Co.
Natrona Co.
Converse Co.



Map 1-1
Project Location
Wyodak CBM Drainage Project

1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T50N
14
16
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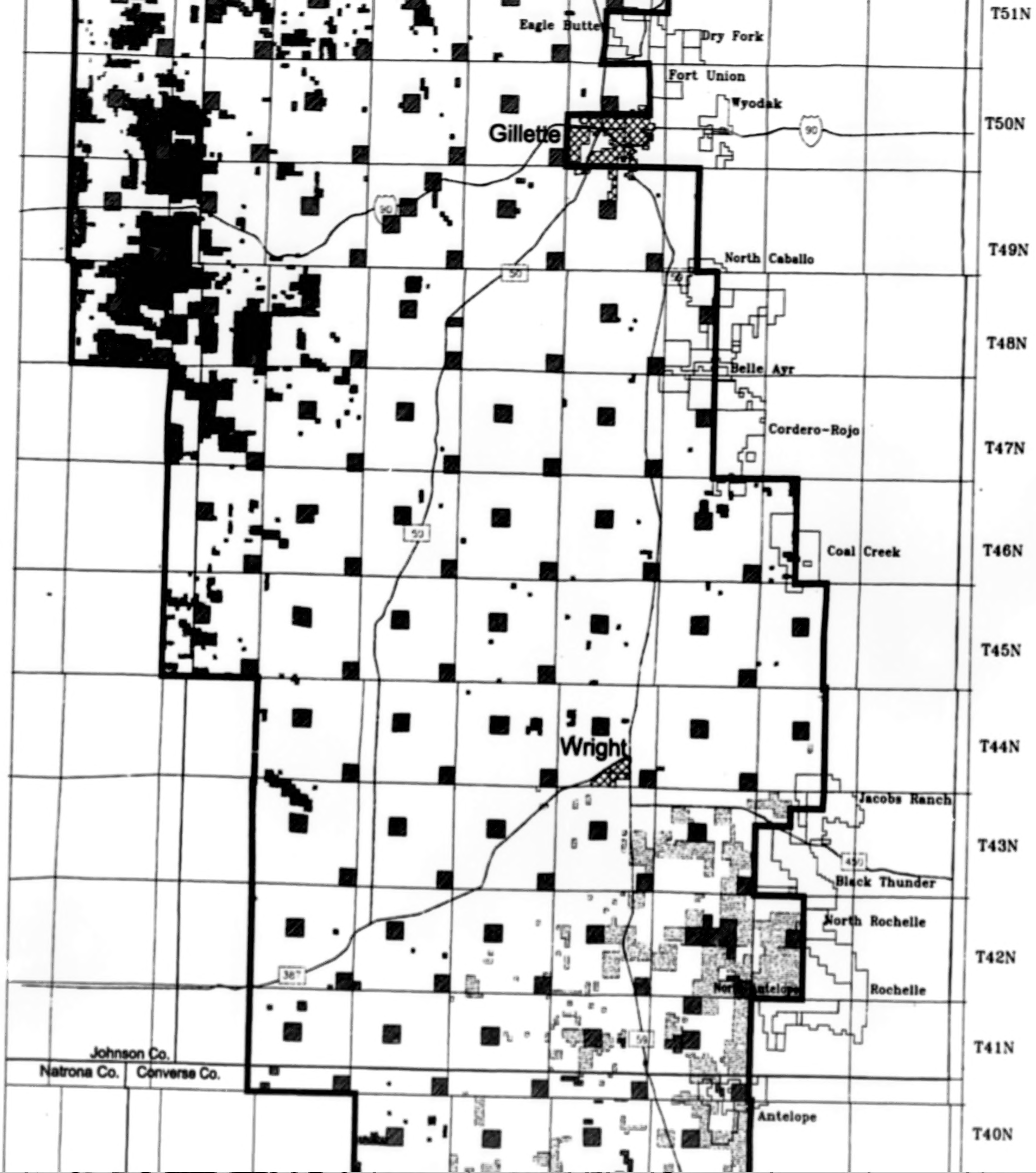
Campbell Co.
Buckskin
Rawhide
Eagle Butte
Dry Fork
Fort Union
Wyodak
Gillette
90
90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Belle Ayr
Cordero-Rojo
T47N
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Coal Creek
T46N
T45N
T44N
Wright
Jacobs Ranch
T43N
450
Black Thunder
North Rochelle
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North Antelope
Rochelle
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Natrona Co.
Converse Co.
Antelope
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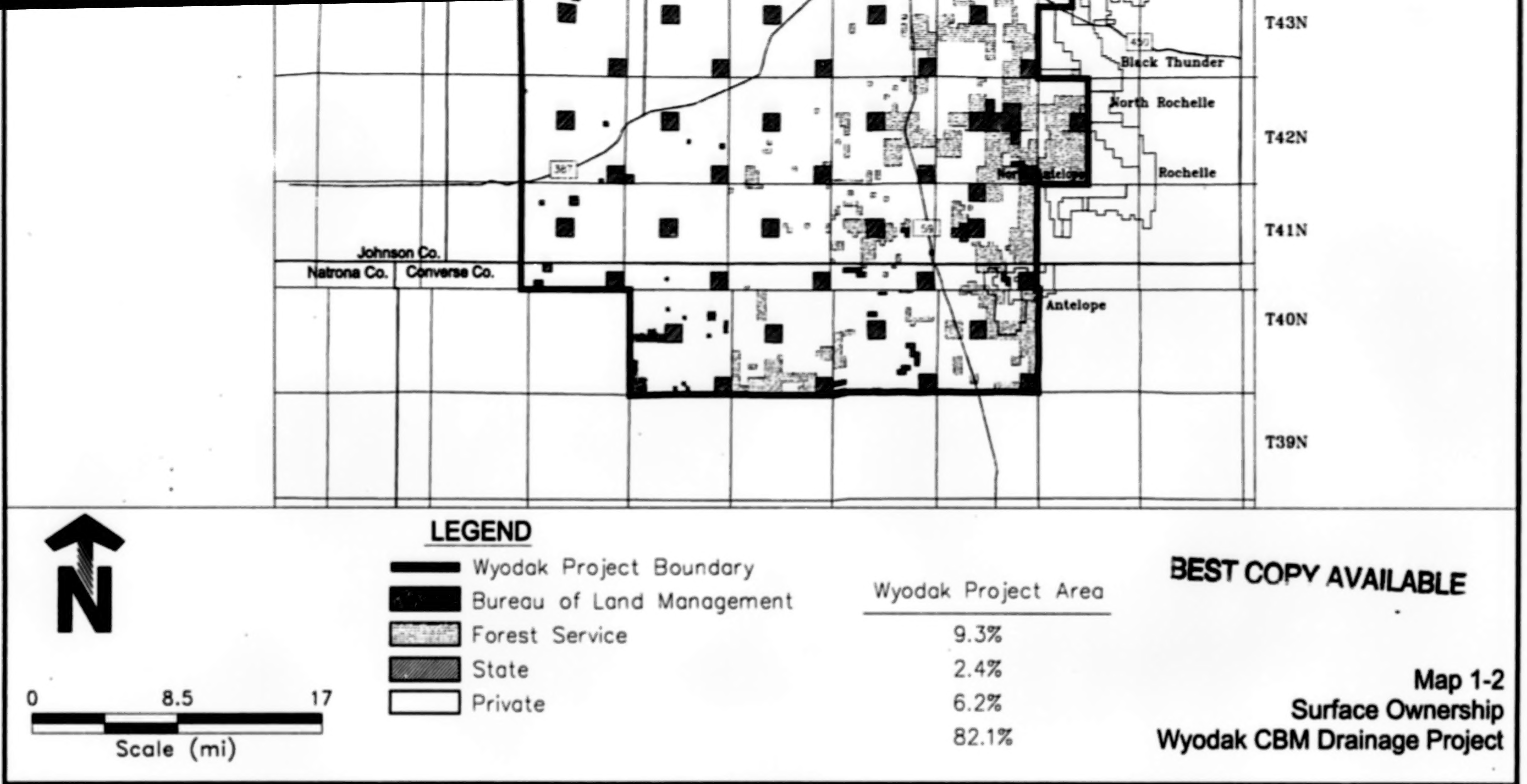
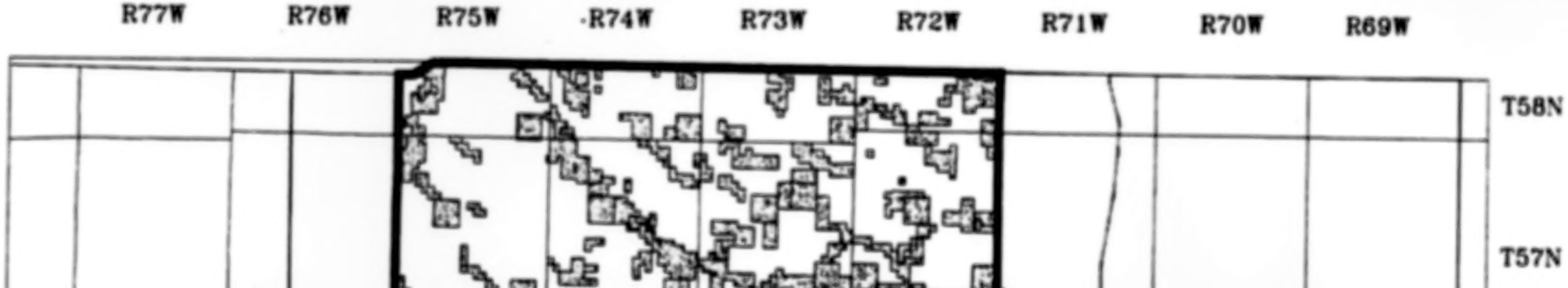


Map 1-2
Surface Ownership
Wyodak CBM Drainage Project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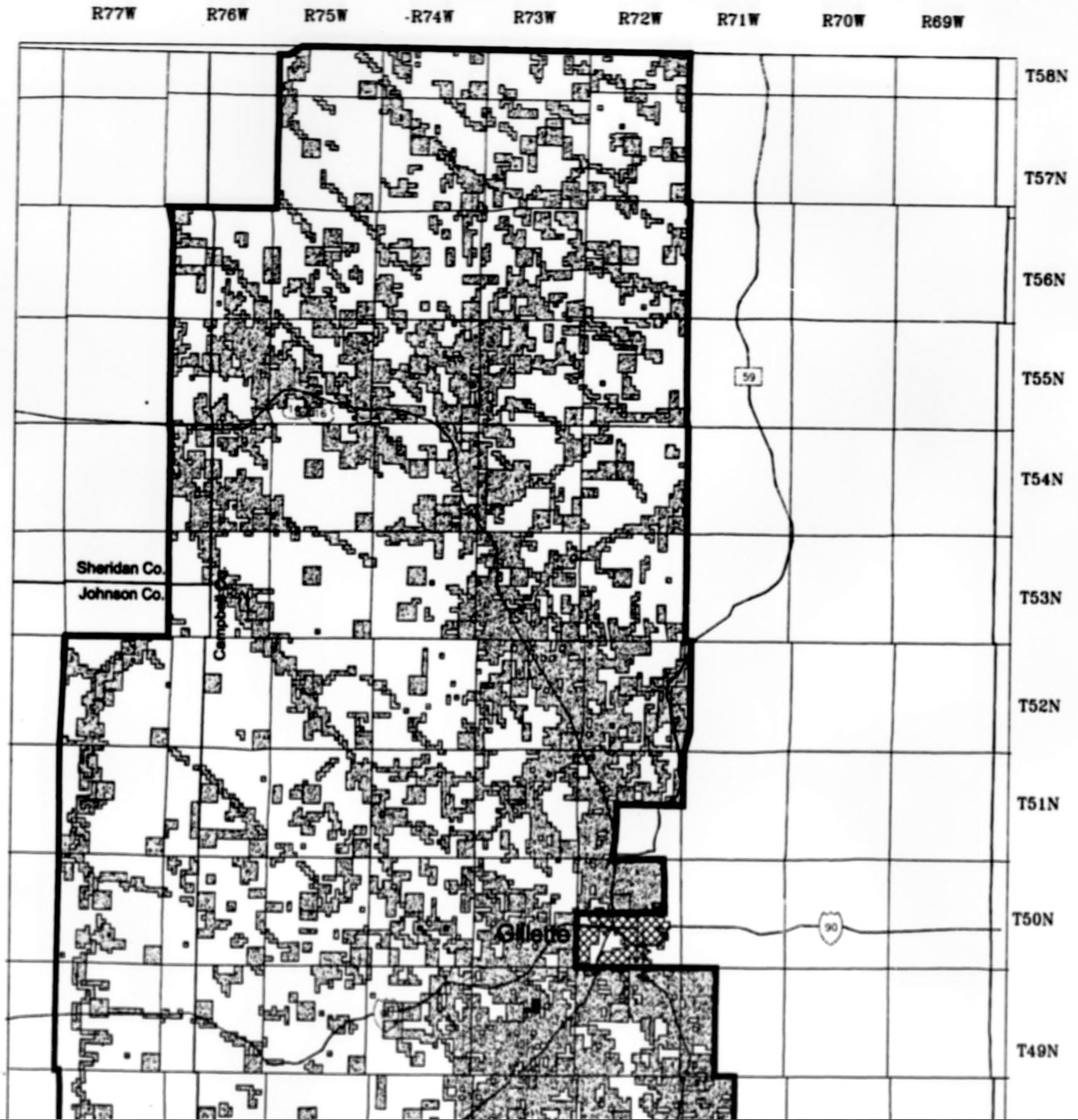
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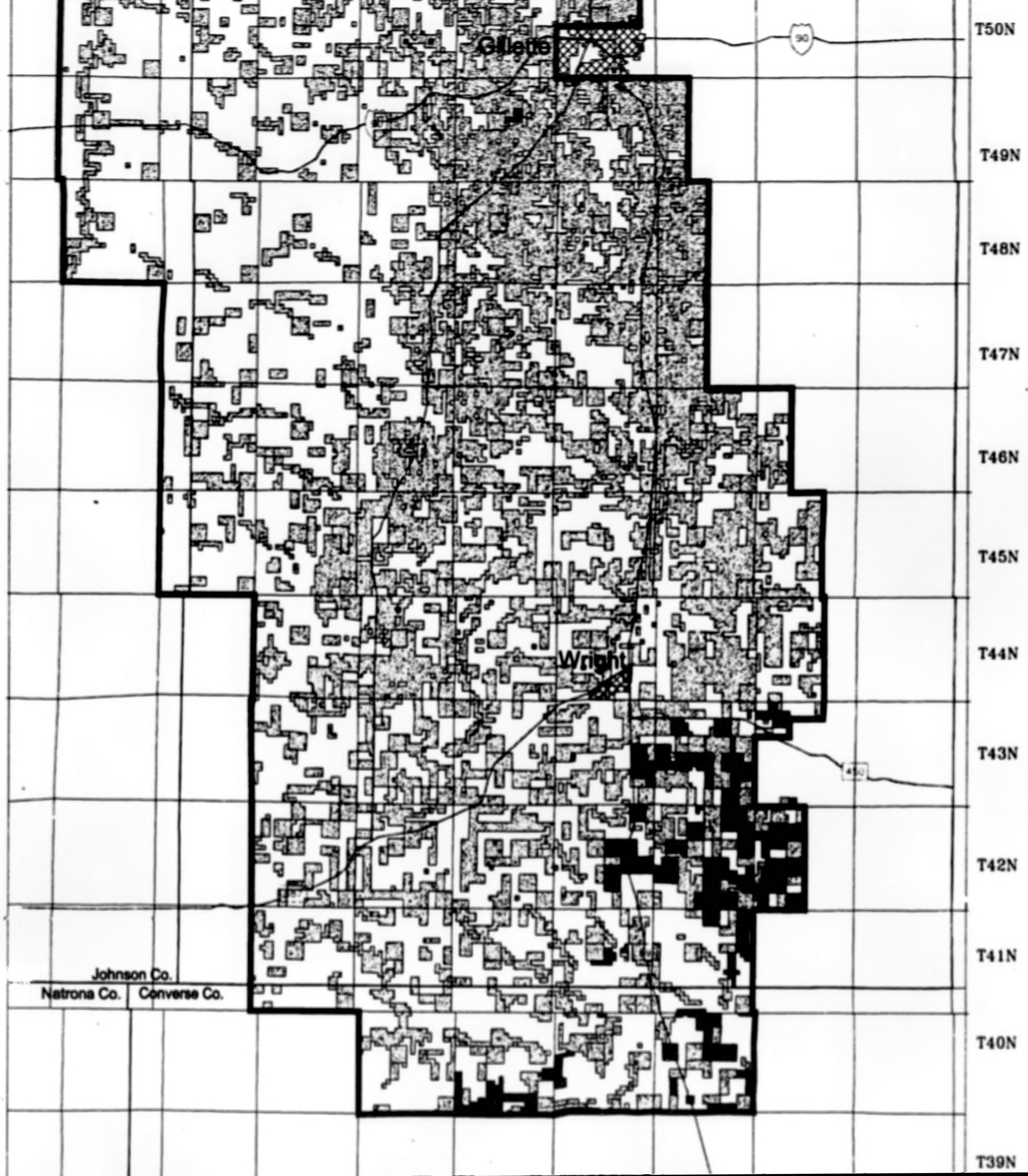
Johnson Co.
Campbell Co.
Gillette
59
16
90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Natrona Co.
Converse Co.
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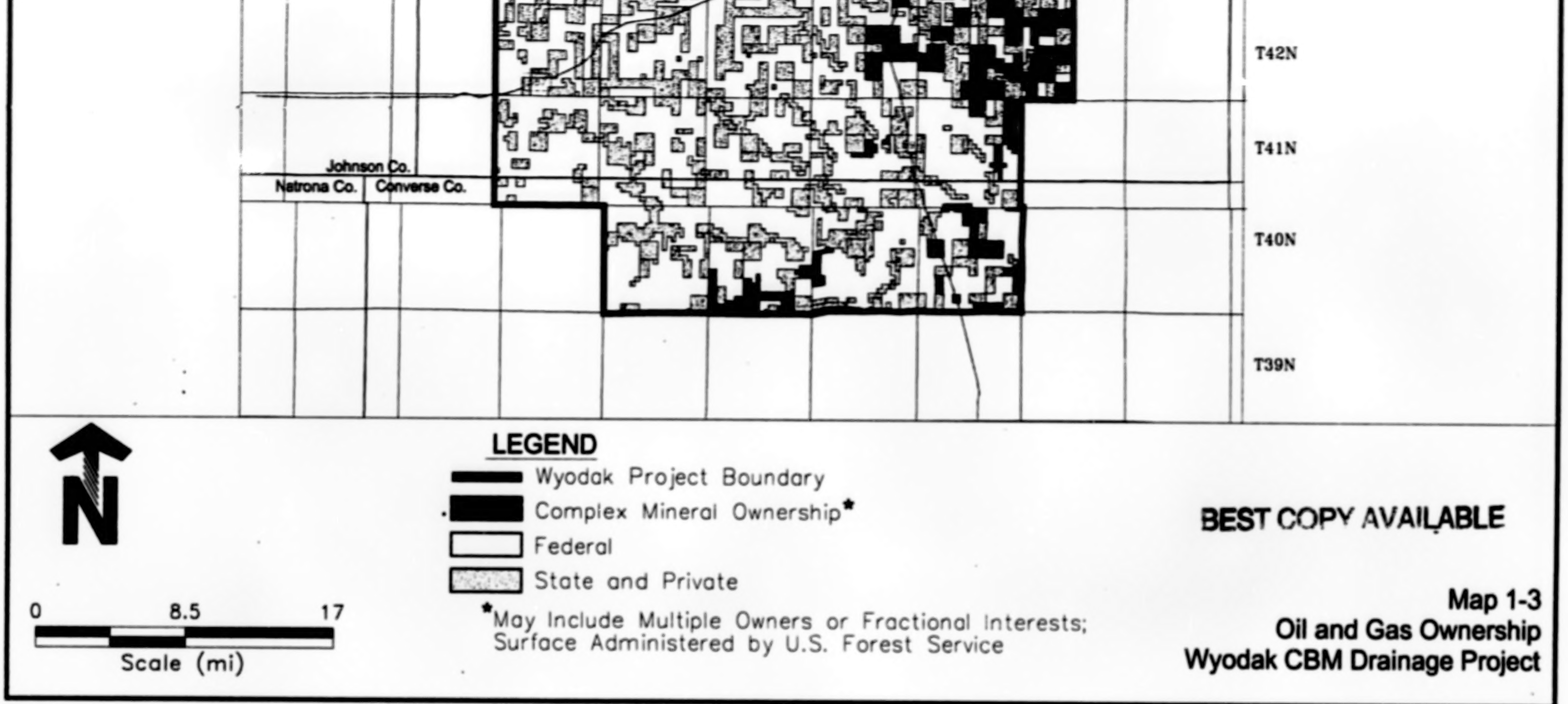
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Natrona Co.
Converse Co.
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LEGEND
Wyodak Project Boundary
Complex Mineral Ownership*
Federal
State and Private
*May Include Multiple Owners or Fractional Interests; Surface Administered by U.S. Forest Service
0
8.5
17
Scale (mi)

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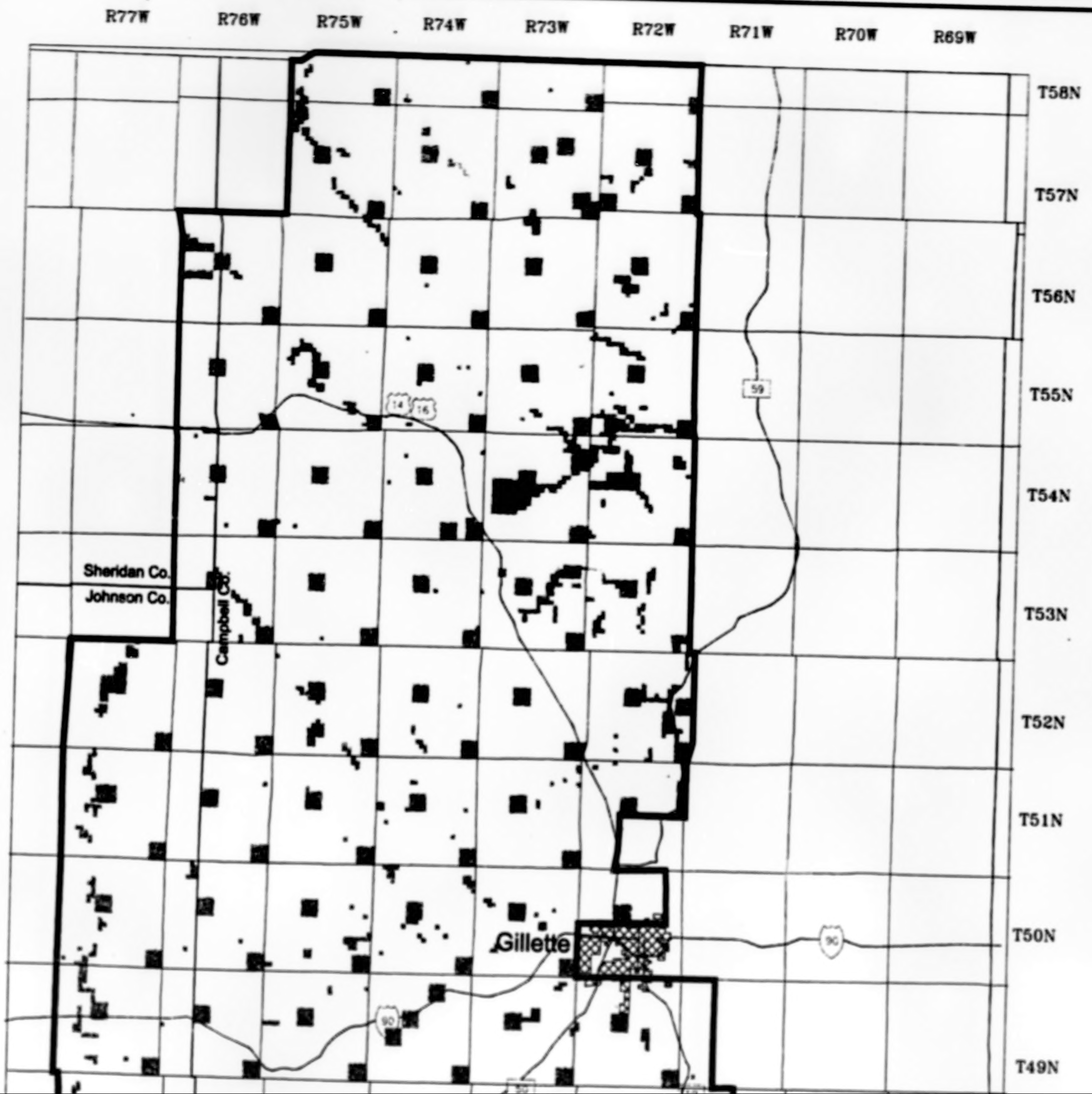
Map 1-3
Oil and Gas Ownership
Wyodak CBM Drainage Project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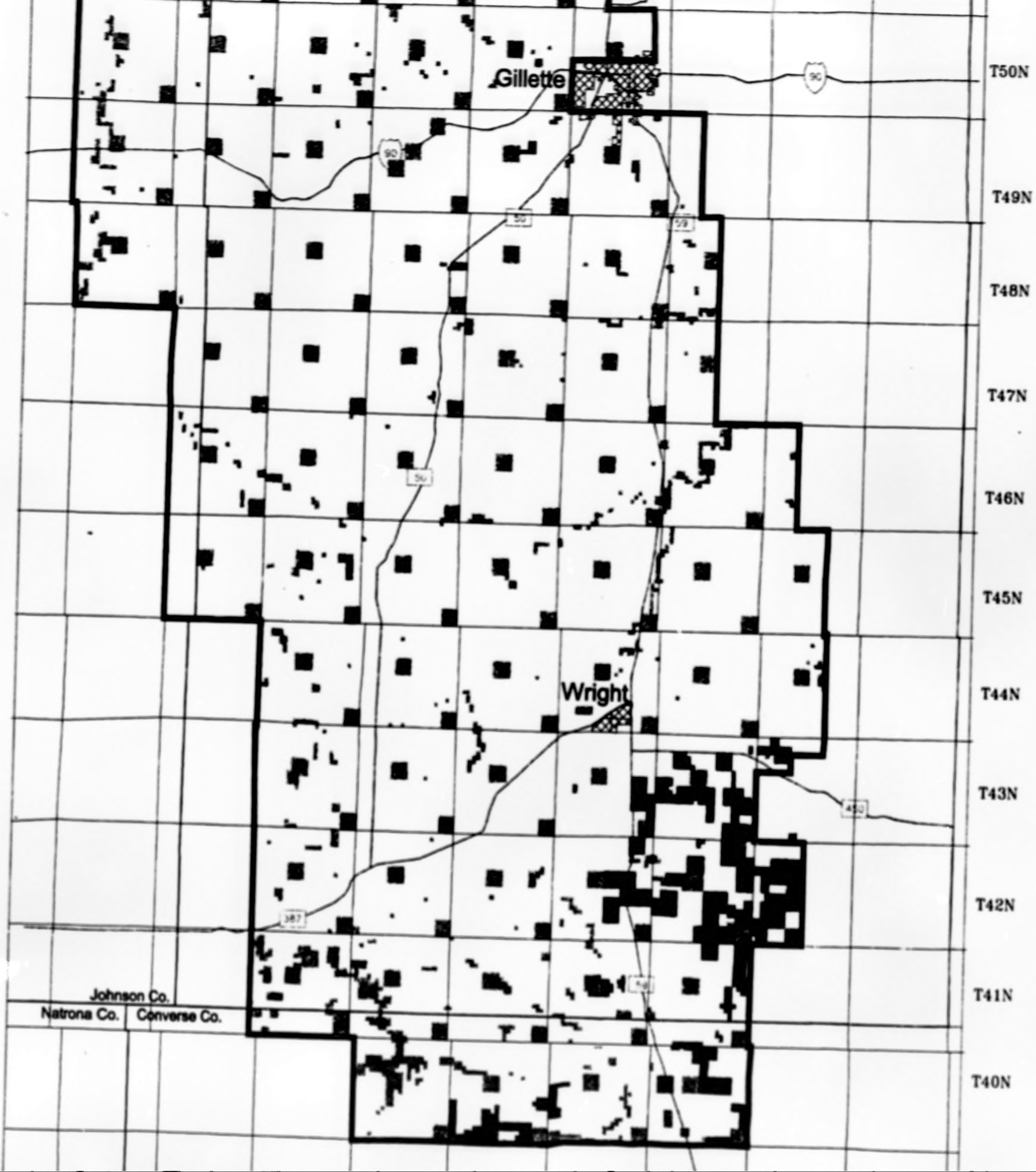
Sheridan Co.
Johnson Co.
Campbell Co.
14
16
59
90
Gillette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Johnson Co.
Natrona Co.
Converse Co.
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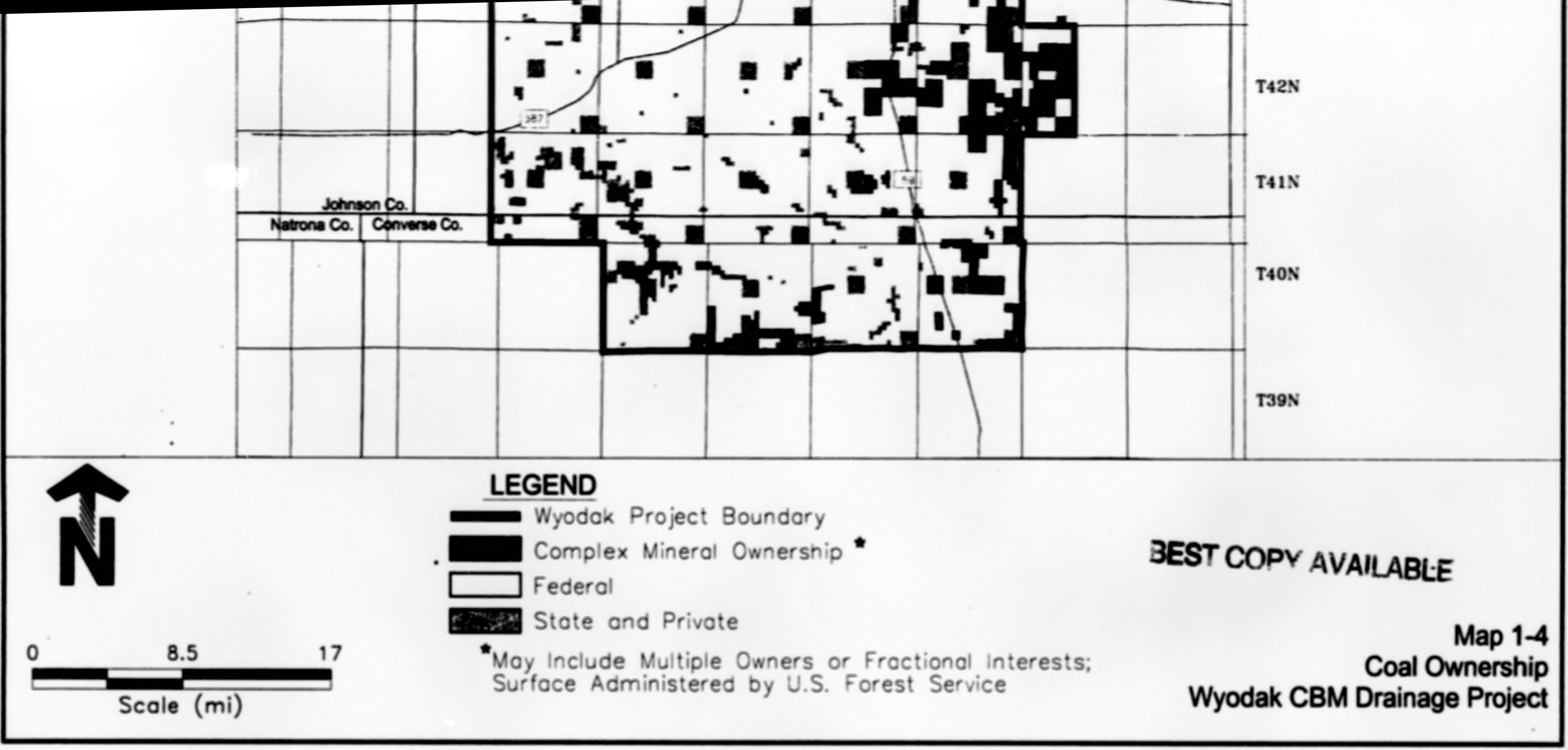

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- ▬ Wyodak Project Boundary
- ■ Complex Mineral Ownership *
- ☐ Federal
- ▨ State and Private

*May Include Multiple Owners or Fractional Interests;
Surface Administered by U.S. Forest Service

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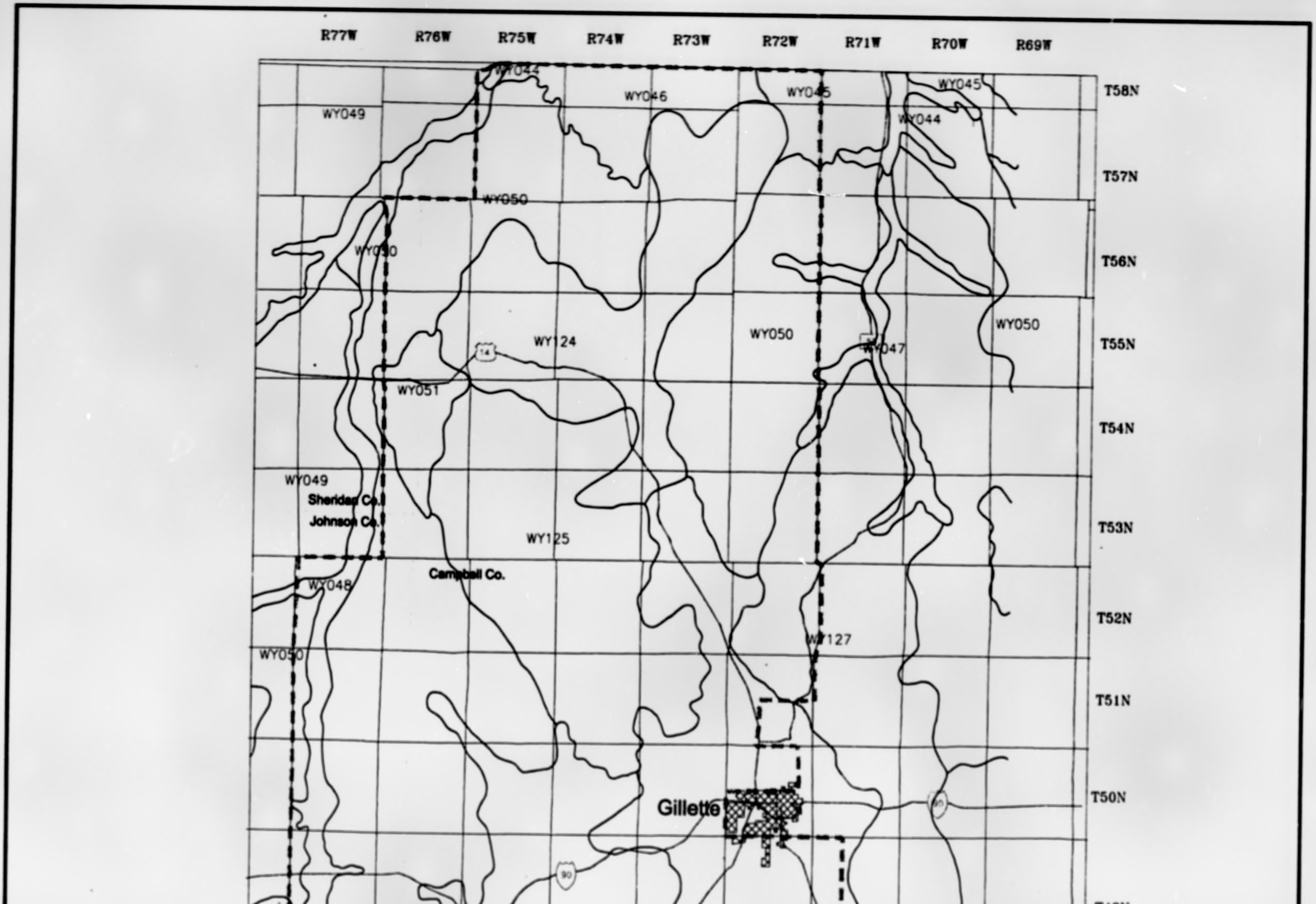
Map 1-4
Coal Ownership
Wyodak CBM Drainage Project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WY046
WY045
WY045
WY049
WY044
WY050
WY030
WY050
WY124
WY050
WY047
14
WY051
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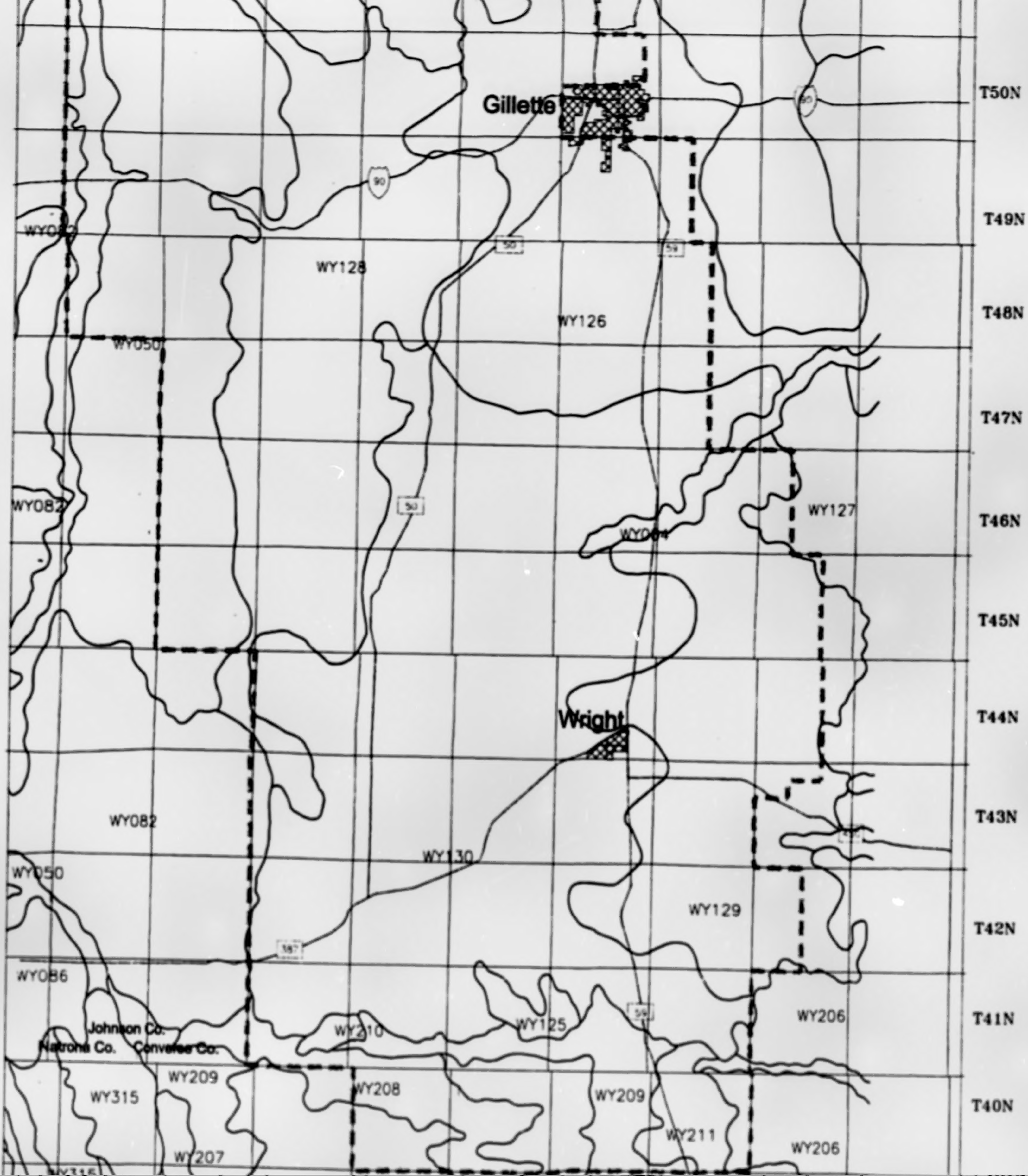
Sheridan Co.
Johnson Co.
WY125
Campbell Co.
WY048
WY127
WY050
Gillette
90
90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WY086
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WY206
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Natrona Co.
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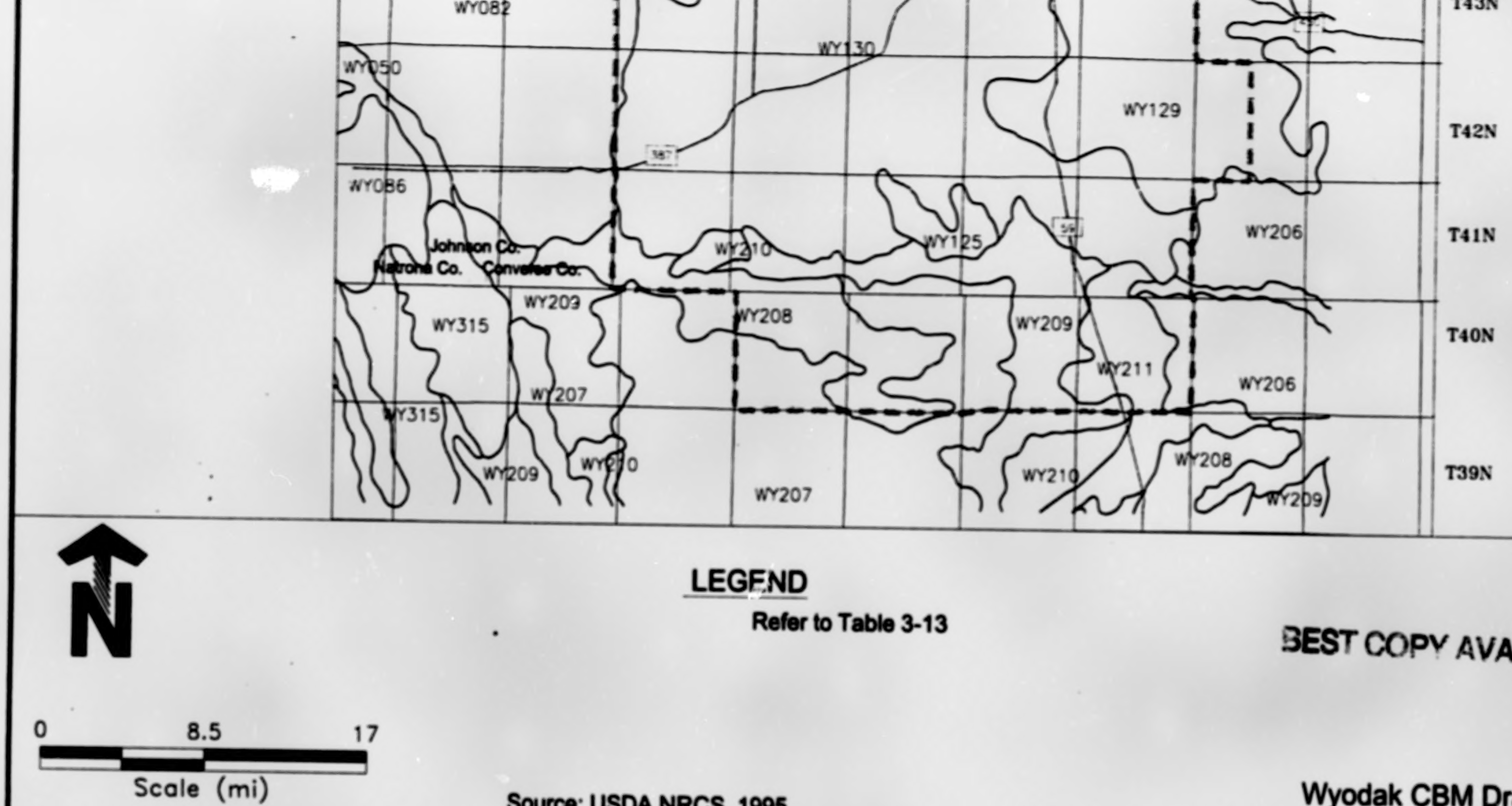

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Refer to Table 3-13

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Source: USDA NRCS, 1995

MAP 3-1
Soils
Wyodak CBM Drainage Project